

ART 183-01, Sum. I, 2022 METAL FABRICATION, Syllabus Name _____

Code #71315. **Sean M. Monaghan, M.F.A. Tel: 831-331-3536; Email: smonaghan@ucsc.edu**

Mon & Wed, 10:00am-4:00pm, June 22- July 20, Summer Session I, 2022, Baskin H101.

SRA: Bruce Kirk, bkirk@ucsc.edu. Head of Studio Operations: J Gaston, jmgaston@ucsc.edu.

Prerequisites are waived for this Summer course. May be repeated for credit. Material fee approx. \$95.

COURSE DESCRIPTION: Intermediate and advanced students will explore the expression of ideas in three dimensions by learning welding, cutting, forming techniques and other processes of metal work by way of demonstrations, lectures, studio work and field trips where feasible. Expect to locate some materials outside of class. Critical thinking, discussion and creative communication of ideas will be stressed as students integrate their sculptural idiom with the skills needed to realize a complete artwork.

PROGRAM LEARNING OUTCOMES:

1. Proficiency in a range of techniques and media. 2. Ability to imagine, create and resolve a work of art. 3. Familiarity with--and ability to--analyze verbally and in writing, issues and forms of contemporary art with a clear understanding of historical precedents. 4. The ability to articulate an insightful response and analysis of a work of art in order to participate in discussions and studio critiques.

EVALUATION/GRADING: Students will be evaluated in five areas, with a maximum of **100 pts:**

A (90+ pts.) Excellent; **B** (80+ pts.) Very good; **C** (70+ pts.) Satisfactory; **D** (60+pts.); **F** (59 or fewer). Points determined by combining strength of ideas and concepts with presentation of the finished project.

- 1) **25 pts: Attendance required at every class. -5 pts.** for missing a class w/o notice, 2 misses = drop.
- 2) **10 pts: Five Basic Exercises:** (2 pts ea.) **Plan, Prep, Layout** (draw, measure, patterns, templates, remove rust, oil, slag); **Cut** (Plasma, Oxy/Acet, grinder w/cutting wheel, chop saw, shears); **Bend** (Hot: gas heat, hammer, anvil, Cold: slip roller, brake, vice or stakes); **Join** (Hot: Gas, MIG, TIG, braze, solder; Cold: bolt, tap, rivet); **Finish:** (file, sand, burnish, seal, display, etc.)
- 3) **20 pts: Lantern Project:** Design, cut and weld the provided steel material into a 'Lantern' form.
- 4) **30 pts: Kinetic Sculpture, Wearable Art or other Approved Final Project:** Design and make a simple 'machine' or sculpture that moves, or a piece that can be worn or will enhance a bodily function, or propose a unique project.
- 5) **10 pts: Clean Ups:** Full participation required: One on first day, one after each project (2 pt. ea.).
- 6) **5 pts: Notebook Review:** One final notebook check: sketches, all handouts, quizzes, etc., w/name.

TEXTS: Required Handouts and instructional materials will be provided.

MATERIALS: Required materials will be provided. Students may bring in approved outside materials.

SAFETY: Safety procedures must be followed as demonstrated. Students must wear cotton or leather long pants and close-toed shoes to class. Other safety gear provided. **Cowell Health Center: 459-2211**

EQUAL ACCESS: UC Santa Cruz is committed to creating an academic environment that supports its diverse student body. If you are a student with a disability who requires accommodations to achieve equal and full access in this course, please submit your Accommodation Authorization Letter from the Disability Resource Center (DRC) to me privately during my office hours or by appointment, preferably within the first two weeks of the quarter. We encourage all students who may benefit from learning more about DRC services to contact DRC by phone at 831-459-2089 or by email at drc@ucsc.edu.

Notify instructor of any injuries or damaged equipment. Be aware of your surroundings.

Keep tables and floors CLEAN. Clean up your stations as you work and at the end of every class!

LAPTOPS and other mobile devices can be a useful tool in the service of teaching and learning, however, use them productively and respectfully. Turn them off before lecture begins, and disable sound. During lecture and classroom discussion, you should not be connected to network resources. To do so invites many distractions - web surfing, email, chats, etc. Chatting or emailing during class is no more acceptable than talking on a cell phone during class time. Additionally, your networked screens are distracting to those sitting near and behind you. If you are found to be doing anything other than note-taking (or sanctioned network activity) you will be asked to leave the class immediately and will be marked as absent for that day. The professor can reserve the right to further legislate laptop use in their classes

LATE ASSIGNMENTS will be accepted with a reduction in grade for lateness for only one week after assignments are due (Please notify me of DRC accommodations before assignments are due so that we can agree on a manageable accommodation.) In this class we abide by the UCSC Principles of Community, so please familiarize yourself here: <https://www.ucsc.edu/about/principles-community.html>

GRADE DISPUTES. If you have questions about the grading of your work, please make arrangements to meet with me. If the matter still remains unresolved, I will advise you on further options.

ACADEMIC MISCONDUCT POLICY. Academic misconduct includes but is not limited to cheating, fabrication, plagiarism, or facilitating academic dishonesty. Acts of academic misconduct during the course, including plagiarism, can and usually do result in failure of the course, at the sole discretion of the instructor of record. Your case will be reported to the College Provost as per the Academic Integrity guidelines found on the web at: https://www.ue.ucsc.edu/academic_misconduct

COURSE EVALUATIONS for faculty will be available online for students to complete towards the end of quarter. There is a new system called WDYT (What Do You Think) and you will be sent emails to your @ucsc.edu email from that system to complete your evaluations online. Please be thoughtful in your responses, as we take them seriously, help faculty improve instruction and are completely confidential.

GRAPHIC CONTENT: In Art courses you will often be assigned images, films or other material that could contain difficult ideas, uncomfortable language, or graphic depictions of sex or violence. You will be asked to treat these portrayals critically, to consider what is being expressed by the maker, or to examine the potential social impact, and to evaluate the works in a given context. Instructors are always happy to speak with you about your work, and might direct you to CAPS (Counseling and Psychological Services) at 831-459-2628 or the Disability Resource Center (831-459-2089) for additional support.

TITLE IX prohibits gender discrimination, including sexual harassment, domestic and dating violence, sexual assault, and stalking. If you have experienced these, you can receive confidential support and advocacy at the Campus Advocacy Resources & Education (CARE) Office by calling (831) 502-2273. Counseling & Psychological Services (CAPS) can provide confidential, counseling support, (831) 459-2628. Report gender discrimination directly to the University's Title IX Office, (831) 459-2462. Reports to law enforcement: UCPD, (831) 459-2231 ext. 1. For emergencies call 911. Faculty and Teaching Assistants are required under the UC Policy on Sexual Violence and Sexual Harassment to inform the Title IX Office should they become aware that you have experienced sexual violence or harassment.

RESOURCES FOR STUDENTS: The art department has a list of many resources on campus available to students. Please take a look at these to see what is available for you: <https://art.ucsc.edu/links-to-student-resources>

REGARDING IN-PERSON INSTRUCTION DURING COVID-19 CONDITIONS:

WHAT WE CAN EXPECT FROM EACH OTHER:

Each individual at UC Santa Cruz should act in the best interests of everyone else in our community. Please take care to comply with all university guidelines about masking in indoor settings, performing daily symptom and badge checks, testing as required by the campus vaccine policy, self-isolating in the event of exposure, and respecting others' comfort with distancing. Please do not come to class if your badge is not green. If you forget your mask, you can ask me for one; there is a limited supply of disposable masks in each classroom. If you are ill or suspect you may have been exposed to someone who is ill, or if you have symptoms that are in any way similar to those of COVID-19, please err on the side of caution and stay home until you are well or have tested negative after an exposure. Let me know that you're not feeling well and I'll respond about how best you can keep learning.

WHAT YOU CAN EXPECT FROM ME:

I have designed our course following campus guidance and with current public health guidelines in mind. However, these guidelines may change in accordance with shifting infection rates or the emergence of new variants. If updated public health recommendations and university requirements make our current course format unfeasible, or if I experience a need to self-isolate, I will alter the format. This may include moving in-person sessions onto Zoom, modifying course assignments to work in a remote format, and reconfiguring exams (if applicable). I will communicate clearly with you via email or Canvas announcement about any changes that occur. I will provide as much advance warning as possible and give you all the information you need to transition smoothly to the new format. If you have questions about the changes, please reach out to me so I can answer them.

WHAT I EXPECT FROM YOU:

If you experience an illness or exposure that requires you to miss class sessions or to attend remotely, please communicate with me as soon as possible and I will provide you with options to allow you to continue making progress in the class. (Alternatively, based on your own plans for instruction, you may want to add specificity to this section; for instance, that you will provide alternative assignments, links to recordings of class sessions, or Zoom links to allow students to participate in class from home.)

6/22 (wed) 10-12: **Course Overview, slides, Safety Demo. Grind tables smooth.** 12-1 Lunch Break.

1-4: **Demonstrate processes and begin Five Basic Exercises:**

Planning and prep (Gather, layout, draw, measure, squares, patterns, templates);

Cut (Hot: Plasma, oxy/acet; Cold: angle grinder, chop saw, foot and Beverly shears);

Bend (Hot: gas heat, hammer, anvil; Cold: slip roller, vice or stakes);

Join (Hot: MIG {TIG; Oxy/Acet, braze, solder}; Cold: drill, bolt, screw, rivet {tap});

Finish (Sanding, file, burnish, sandblast, color, seal, presentation, etc.).

6/24 (fri) 10-12: **Finish 5 Basic Exercises.** 12-1 Lunch break

1-2: **Continue working on 5 Basic Exercises and begin sketches for Lantern Project.**

6/27 (mon) 10-12: **Continue working on 5 Basic Exercises.** 12-1 Lunch Break.

1-2: **Critique 5 Exercises and look at sketches for Lanterns.** 2-4: **Begin Working.**

6/29 (wed) 10-12: **Continue working on Lantern Project.** 12-1 Lunch Break.

1-4: **Continue working on Lantern Project.**

7/4 (mon)

<< No Class >>

<< Independence Day Holiday >>

7/6 (wed) 10-12: **Continue working on Lantern Project.** 12-1 Lunch Break.

1-2: **Slides: Kinetic, Wearable or other Approved Final Project.** 2-4: **Begin Sketches.**

7/11 (mon) 10-12: **Finish Lantern Project.** 12-1 Lunch Break.

1-2: **Critique Lantern Project and look at Final Project sketches.** 2-4: **Begin Working.**

7/13 (wed) 10-12: **Work on Kinetic, Wearable or other Approved Final Project.** 12-1 Lunch Break.

1-4: **Continue working on Final Project.**

7/18 (mon) 10-12: **Continue working on Final Project.** 12-1 Lunch Break.

1-4: **Continue working on Final Project.**

7/20 (wed) 10-12: **Finish Final Project.** 12-1 Lunch Break.

1-2: **Clean;** 2-4: **Final Project Critique and Potluck!**

Welding supplies: Matheson Welding (River St.), **General supplies:** San Lorenzo Lumber (River St.)
Steel: Central Coast Welding (Ingalls St.), Geo Wilson (Harvey West); **Copper:** Bruce Mech. (Coral St.)
Misc. found objects and scrap: City Dump (Dimeo Ln.), Bike Church (Pacific St.), Thrift stores, etc.

Five Basic Exercises, Check list:**1. Planning and prep** (Gather materials, layout, draw, measure, squares, patterns, templates);

- _____ Clean a section of 18 gauge sheet steel. Layout and mark one piece @ 6" x 24" pc. Within that:
- _____ Layout 2 @ 6" x 6" squares. Divide one in thirds: 3 @ 2" x 6", and quarter the other: 4 @ 3" x 3".
- _____ From the remainder of the original 6" x 24" piece, layout and mark 2 @ 12" x 3" rectangles.
- _____ Clean a 36" section of mild 3/16" dia. steel rod. Layout and mark 2 @ 12" long and 2 @ 6" long.

2. Cut (Hot: Plasma {*opt: oxy/acetylene*}; Cold: Foot and Beverly shears, angle grinder, chop saw);

- _____ Cut 1 pc. @ 6" x 24" with **Foot Shear**. From this cut 2 @ 6" x 6" & 2 @ 3" x 12" w/ **Foot Shear**.
- _____ Cut one 6"x6" into 3@ 2"x 6" pcs. w/**Plasma**. Quarter 2nd 6"x6" to 4@ 3"x 3" w/ **Beverly shear**.
- _____ Cut two of the 2" x 6" pieces in half (4 @ 2" x 3") using the **angel grinder w/cutting wheel**.
- _____ Use the remaining 2" x 6" piece to cut at least 3 holes of random sizes and shapes with **Plasma**.
- _____ Cut 2 @ 12" long x 3/16" dia. rod, and 2 @ 6" long x 3/16" dia. rod with **Chop Saw**.

3. Bend (Hot: gas heat, hammer, anvil; Cold: slip roller, vice or stakes);

- _____ Clean any slag and **Slip Roll** 2 @ 3" x 12" sheet pcs. on slip roller to 1 @ 10" dia. and 1 @ 5" dia.
- _____ Clean any slag and **Slip Roll** 2 @ 12" x 3/16" rod on slip roller into 1 @ 10" dia. and 1 @ 5" dia.
- _____ Bend the 2" x 6" piece (with the Plasma holes) in half, lengthwise, to 90° on **Finger Break**.

4. Join (Hot: MIG {*opt: TIG; Oxy/Acetylene, braze, solder*}; Cold: drill, bolt, screw, rivet, {*opt: tap*});

- _____ Weld 2 @ 3" x 3" together flat, and 2 @ 3" x 3" together at 90° with **MIG** welder. 'Sign' flat pc.
- _____ On the bent 2" x 6" piece: Use **MIG** to draw at least 6 @ 2" long beads: 4 straight, 2 curved.
- _____ Weld rolled rods to respective arcs w/**MIG** welder. Tack each end, and 3-4 times along arc.
- _____ Drill 4 holes at 1/8" and 4 at 9/32", using **Drill Press**. Attach with 1/8" rivets and #8-32 screws.

5. Finish (Sanding, file, burnish, sandblast, color, seal, presentation, etc.).

- _____ Use **angle grinder**, file, wire brush or sand paper to smooth edges on two Plasma cut pieces.

Welding Terminology:

Welding: Any method—usually ‘hot’—for fusing pieces of similar metal: Arc (1802) or Gas (1903).
Arc Welding: Uses an electrical arc to weld: Stick, MIG or TIG (or **GMAW:** Gas Metal Arc Welding)
Braze: Joining base metal (usually steel) with different filler metal (usually brass or bronze) at high temperatures (~2,000°F). **Solder:** Like brazing, but at lower temp’s (500°F ~1,500°F), often w/silver.
Flux: Use when brazing or soldering; keeps brazing area clean of oxides, allows filler to flow better.

MIG* Welding (*Millermatic 251 and 252*) *Metal Inert Gas, since 1948

SAFETY: Use #10 helmet. Provide adequate ventilation. Wear leather jacket, gloves, long cotton pants and close-toed shoes to protect eyes and skin from UV and IR rays.

1. Clean and prep metal pieces, then secure with bricks or clamps into proper position for welding.
2. Turn ON Ventilation switch at wall and work near vent in order to pull harmful fumes away.
3. Ground work by attaching ground clamp, either to metal table or directly to work.
4. Check that the torch nozzle and cover are clean and in good order. Dip nozzle in Gel to keep clean.
5. Turn on Argon tank (pre-set at 20 psi). Snip off wire about 1/4” from nozzle. Turn on the MIG.
Refer to chart to set Voltage and Wire Speed. Ex: 18 gauge = 14-15Volts, 120-130 Wire Speed.
6. Hold the torch so that the wire is about 1/8” from work. Pull the trigger to produce a weld.
7. ‘Tack’ the pieces to be welded. Complete the weld by moving the torch evenly along weld path.
8. When done: turn OFF power & Argon, remove ground, hang up torch. Work is hot! **Clean up!!!**

Plasma Torch Cutting (*Miller Spectrum 875*) Since 1955

SAFETY: Use #5 face shield. Provide adequate ventilation. Wear hearing protection, gloves, leather jacket, long pants and close-toed shoes. Protect eyes and skin from UV and IR rays.

1. Clean the metal of oil, etc. Mark cuts with slate or make a template (wood or metal) if necessary.
2. Turn ON ventilation switch at wall and work near vent to pull fumes away.
3. Ground work by attaching ground clamp to either the metal table or directly to piece being welded.
4. Check the torch and insure that electrode, nozzle and cover are clean and in good working order.
5. Turn on compressed air valve (~20psi). Turn on the Plasma Cutter (~25 Amps for 18 gauge steel.)
6. Set to ‘Cut’. Keep fingers away from cutter, and do not point at anyone. Work over a cutting table.
7. Place nozzle lightly on the piece, at 90°, on the cut line. Pull the trigger to produce a cutting arc.
8. Once metal is pierced, steadily move the nozzle along line. (A stencil may be used w/~1/8” gap.)
9. When done, turn OFF power, air, remove ground, hang up torch. Work is hot, sharp. **CLEAN UP!!!**

Notes:

Steel rod appears reddish, because it is copper-plated. It is magnetic and it will spark.

Brass rod appears ‘yellow,’ **Bronze rod** looks ‘pink-orange.’ They are not magnetic and won’t spark.

Stainless steel rod is not coated, therefore it appears ‘silvery’. It is not magnetic but it will spark.

Most Valves are ‘righty-tighty’ (clockwise) to close, ‘lefty-loosey’ to open.

‘**Disc**’ and ‘**Ball**’ valves only turn 90°: handle is in line w/pipe if ‘Open,’ crosses pipe if ‘Closed.’

Fuel line threads for Acetylene and Propane are reversed for safety, to avoid misconnection.

Pressure Regulators (Oxygen, Acetylene and Compressed air) work in reverse: ‘Open’ by turning clockwise, ‘Close’ by turning counter-clockwise. (Only unscrew until loose. Do not allow to fall out.)

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TIG* Welding (*Syncrowave 250*)

(Also known as 'Heliarc' or 'Electrode' welding) *Tungsten Inert Gas, since 1941)

SAFETY: Use #10 helmet. Provide adequate ventilation and **never expose your eyes or skin (or those near you) to the light emitted from the torch: gloves, jacket, long pants, close-toed shoes.**
Ask Instructor or Monitor before using the TIG welder for the first time.

1. Prepare: Clean, level, secure and ground metal to be welded, using bricks if needed. Turn on the TIG: flip the power switch on upper right of panel. Open the 'noble' gas tank (Argon).
 2. Set Output Selector at DC- : "CEN or TIG"; Arc Control to "Off"; High Freq. to "Start."
 3. **Aluminum Only:** Output Sel. to "AC;" Arc Control to "Off"; High Frequency to "Continuous."
 4. Set the Amperage Adjustment as needed, usually at about 180 for 3/16" thick bronze pieces.
 5. The tungsten electrode should be clean, pointed, and protrude about 1/8" past ceramic nozzle.
 6. **To weld:** Position tungsten electrode at a 70° angle, about 1/8" above level work, with your welding arm supported. Close helmet and press the foot-pedal. An arc will span from the electrode to the metal. Do not touch metal with electrode. As a shiny puddle forms, introduce rod. Gently circle torch and gauge heat with the foot pedal. To stop, release pedal and pause a moment over the new weld. **TIG tip is very hot!** Repeat as necessary, turning work to keep it level.
- To shut down,** turn off the TIG welder and fully close the tank of gas. TIG welding is very efficient, but work still gets very hot. Move work to a safe area, secure the torch and clean up.

Gas Welding and Cutting with Oxygen and Acetylene tanks (*Since 1903*)

SAFETY: Use #3 goggles (or face shield) for gas welding bronze (use #5 to weld steel).
Provide adequate ventilation. Wear good gloves, long sleeves, long pants and close-toed shoes.
Ask Instructor or Monitor before using the Oxy/Acetylene welder for the first time.

1. **Prepare:** Clean and bevel the metal to be welded. Level and secure the piece(s) with bricks, etc.
2. Turn on ventilation switch at wall. Check that the valves of the torch body are snugly closed.
3. Select the appropriate torch tip, usually #1 or #2. (Ranges: #000, #00, #0, #1, #2, #3, #4, #5)
4. Check that wing-nuts on regulators are closed (*counter-clockwise & loose... but not falling out*).
5. Open the main valve of the Acetylene about one-quarter turn (so that it can be quickly closed).
6. Open the main valve of the Oxygen one full turn.
7. Open regulators to adjust gas pressure: about 5 psi for Acetylene, about 20 psi for Oxygen.
8. **Light the torch:** Point toward ventilation. Opening the Acetylene at torch body about 1/4 turn. Ignite with striker. Adjust Acetylene until the flame 'splay' is about one inch from tip. Adjust Oxygen at torch to achieve a 'neutral' flame (when the two small cones come together).
9. Heat area to be welded by circling torch, keeping blue cone 1/8" above the surface. Pull torch away *frequently* to check that heat is an even orange. Heat welding rod and dip into flux. Continue to heat evenly until a 'shiny puddle' appears at weld site. Introduce rod into puddle and keep circling.
10. **Cutting (steel only):** Remove welding tip and attach cutting head, hand-tight only! Adjust flame as for welding above, then press lever and readjust. Heat metal until liquid, then press lever to cut.
11. **To shut down,** reverse the operation. On torch body: turn off Oxygen first, then Acetylene. Next, close the main valves on the Acetylene and Oxygen. Close both regulator wing-nuts, and bleed lines by opening both valves at the torch body, then closing them. Leave wing-nuts loose. Use care when moving hot pieces! Hang hoses and clean up. Move piece to a safe area. Sandblast flux.

Foot Shear:

SAFETY: Make sure that no one else is located within the yellow paint marks!
Mark material and place mark at the front edge of the blade, or use provided graduations. Maintain balance while using both feet to press down on foot pedal with several controlled 'pushing' motions.

Beverly Shear:

Throatless shears allows sheet metal to be rotated during cutting. Do not cut rod! Keep lever on stand.

Slip Roller:

SAFETY: **Do not get fingers near the rollers. Hold roller open w/bar to remove a cylinder.**
Remove slag and place clean material at 90° to the rollers, or a 'spiral' will result. Gradually adjust bottom screws to tighten the radius as you go. Keep rollers parallel, or a cone will result.

Box or Pan Sheet Metal 'Finger' Brake:

A manually-operated brake with counterweights. The adjustable 'fingers' accommodate full-length or partial bends, for boxes and pans. For sheet 12 gauge mild steel only: do not bend rod or bar stock!

Pedestal Grinder:

SAFETY: **Clear faceshield or goggles. Protect eyes, ears, lungs, hands. No loose hair or clothes.**
Hold work at front/center of wheel. **Wire Wheel can grab your piece!** Buffing wheel requires rouge.

Right-angle Grinders:

SAFETY: **Clear faceshield or goggles. Protect eyes, ears, lungs, hands. No loose hair or clothes.**
Use an electric **right-angle grinder** to cut, grind or sand metal. Use dust mask. Protect ears and eyes. Make sure that no one is in the 'plane' of material being removed and thrown by the grinder. Cutting discs are thin and can break easily, causing flying shards. No loose clothes or hair! **SWEEP UP!!!**

Floor Drill Press:

SAFETY: **Clear faceshield or goggles. Protect eyes, ears, lungs, hands. No loose hair or clothes.**
Table can be adjusted up, down, left, right. Secure work with clamp or vice. Secure bit in chuck with key. Always remove chuck key before turning on! Adjust drill speed with the black dial: use slower speeds to drill metal. **Push Red Button** to stop. Hole depth is adjustable. Use feed lever to slowly lower bit.

Metal Chop saw:

SAFETY: **Clear faceshield or goggles. Protect eyes, ears, lungs, hands. No loose hair or clothes.**
Secure work against the fence with the adjustable vice. The cutting wheel wears down, so make sure that there is enough wheel for your depth of cut. Leave guard in place. Press power switch and cut **slowly**.

12" Disc Sander:

SAFETY: **Clear faceshield or goggles. Protect eyes, ears, lungs, hands. No loose hair or clothes**
Place material securely on left side of table. Final finishing of flat surfaces only! (Disc dulls quickly).

Sandblaster:

SAFETY: **Dust mask and earplugs. Always run exhaust before, during and after opening door.**
Blasting removes rust and slag and protects files. It also provides a good surface for paint or sealers.