

**ART 183, Sum. II, 2017      METAL FABRICATION, Syllabus      Name \_\_\_\_\_**

**Sean M. Monaghan, M.F.A. Studio Tel: 831-454-9098; Email: sean@seanmmonaghan.com.**

Code # 70933. Tue-Thu, 9:00am-4:00pm, August 1<sup>st</sup>-31<sup>st</sup>, Summer 2017, Baskin H101.

Campus Tel: 459-2846; Campus Email: smonagha@ucsc.edu (Contacts in **bold** above are preferred.)

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, etc.).
- 3) **10 pts: Lantern Project:** Design, cut and weld the provided steel material into a 'Lantern' form.
- 4) **20 pts: Wearable Art:** Design and make a piece that can be worn or will enhance a bodily function.
- 5) **20 pts: Mechanical Device:** Design and make a simple 'machine' and demonstrate its purpose.
- 6) **10 pts: Clean Ups:** Full participation required: One on first day, one after each project (2 pt. ea.).
- 7) **5 pts: Notebook Review:** One final notebook check: sketches, all handouts, quizzes, etc., w/name.

**TEXTS:** Required Handouts and instructional materials will be provided.

**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!**

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8/1 (tue) 9-12: 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: Oxy/Acetylene MIG, TIG, Arc (stick), braze, solder; Cold: bolt, tap);

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

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8/3 (thu) 9-12: Finish 5 Basic Exercises. 12-1 Lunch break

1-1:30: Clean; 1:30-3 Critique, 3-4: Introduce Lantern Project.

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8/8 (tue) 9-12: Work on Lantern Project. 12-1 Lunch Break.

1-4: Continue working on Lantern Project

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8/10 (thu) 9-12: Finish Lantern Project. 12-1 Lunch Break.

1-1:30: Clean; 1:30-3 Critique Lantern Project. 3-4: Intro to Wearable Art project.

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8/15 (tue) 9-12: Work on Wearable Art Project. 12-1 Lunch Break.

1-4: Continue working on Wearable Art Project.

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8/17 (thu) 9-12: Continue working on Wearable Art Project. 12-1 Lunch Break.

1-4: Continue working on Wearable Art Project.

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8/22 (tue) 9-12: Finish Wearable Art Project. 12-1 Lunch Break.

1-1:30: Clean; 1:30-3: Critique Wearable Art Project. 3-4: Intro Mechanical Device.

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8/24 (thu) 9-12: Work on Mechanical Device Project. 12-1 Lunch Break.

1-4: Continue working on Mechanical Device Project.

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8/29 (tue) 9-12: Continue working on Mechanical Device Project. 12-1 Lunch Break.

1-4: Continue working on Mechanical Device Project

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8/31 (thu) 9-12: Finish Mechanical Device Project. 12-1 Lunch Break.

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

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**Welding supplies:** Matheson welding (River St.)

**Steel and Copper\*:** Central Coast Welding (Ingalls St.), Geo Wilson (Harvey West), \*Bruce (Coral St.)

**Misc. found objects and scrap:** City Dump (Dimeo Ln.), Bike Church (Pacific St.), Thrift stores

### Welding Terminology:

**Welding:** Any method—usually ‘hot’: Gas (1903) or Arc (1802)—for fusing pieces of similar metal.  
**Arc Welding:** Using an electrical arc to weld: Stick, MIG or TIG. **GMAW:** Gas Metal Arc Welding.  
**Brazing:** Joining base metal (usually steel) with different filler metal (usually brass or bronze) at high temperatures (~2,000°F). **Soldering:** Like brazing, but at lower or medium temp’s (500°F ~1,500°F).  
**Flux:** Used when brazing or soldering to keep brazing area clean and to allow solder to flow better.

### 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.  
**Butterfly valves** only turn 90°: handle is in line w/valve if ‘Open,’ handle crossing valve if ‘Closed.’  
**Fuel line** threads for Acetylene and Propane are reversed for safety, to avoid misconnection.  
**Pressure Regulators** (Oxygen, Acetylene, Compressed air) work in reverse: ‘Open’ by turning clockwise, ‘Close’ by turning counter-clockwise. (Only unscrew until loose. Do not allow to fall out.)

### 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. 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, either to metal table or directly to work.
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. Set the nozzle lightly on the work, at 90°, on the cut line. Pull the trigger to produce a cutting arc.
8. Once work 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!!**

**Gas Welding** with Oxygen and Acetylene (*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. **To cut steel (only):** Remove welding tip and attach cutting head, hand-tight only! Adjust flame as for welding above, then press handle and readjust. Heat metal until liquid, then press handle, 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.

**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 work the same way as for gas, except metal must be grounded, and no flux is needed.
2. Turn on the TIG: flip the power switch on upper right of panel. Open the 'noble' gas tank (Argon).
3. Set Output Selector at DC- : "CEN or TIG"; Arc Control to "Off"; High Freq. to "Start."
4. **Aluminum Only:** Output Sel. to "AC;" Arc Control to "Off"; High Frequency to "Continuous."
5. Set the Amperage Adjustment as needed, usually at about 180 for 3/16" thick bronze pieces.
6. The tungsten electrode should be clean, pointed, and protrude about 1/8" past ceramic nozzle.
7. **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.
8. **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.

**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 in any direction during cutting. Do not cut rod!

**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.

**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).

**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. Always remove chuck key before turning on! Speed and depth are 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 blade for your depth of cut. Leave guard in place. Press power switch and cut slowly.

**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.