2023 Additive Manufacturing

Contest Date: April 15th

Orientation: 8:00 am Amway Grand Plaza Hotel – Room to be determined at later date.

- Competition will begin immediately after orientation. All competitors must check-in by 8:00 am. Computers and other related items may be dropped off prior to competition.
- Orientation and Contest area will be closed to observers until 11:00 am. No instructors are permitted inside the contest zone.

Competition: 8:30 am – TBD (Based on the total number of teams)

- Upon arrival at orientation, students will be provided with the timeslot for their competition. The first timeslot will begin at ~8:30 am and will run every 30min until we have accommodated the number of teams there to compete.
- Students are to return to the competition area 30 min after the last timeslot (official time will be provided at the competition) to hear which teams will be called back for the 2nd round of group judging. The top-placing teams will be selected from this group.

Purpose: To evaluate each contestant's preparation for employment and to recognize outstanding students for excellence and professionalism in the field of Additive Manufacturing.

Contestants: 1 team (2 students) from each school that has pre-registered to be part of the event.

Requirements: Each team is responsible for bringing their 3D Printed model to the competition for testing. No parts will be printed at the competition. Models must adhere to the contest outlines from the proposed standards.

Clothing: Clothing Requirements:

White collared shirt – No logos
Black Tie
Black slacks
Black leather shoes solid black
Black accessories

Contest Criteria

On contest day, students will:

- Provide Engineering Notebook (Engineering notebook guidelines below)
- Present Design to judges and answer questions.
- Showcase the functionality of the 3D printed component.
- Provide resumes to judges (each participant must have one, these will not be collected, only verified that they have them).

Engineering Notebook Guideline:

- The Engineering Notebook should contain robust content, including at a minimum the following:
    - Be clearly labeled with contestant name(s), date and page # on each page
    - Begin with a problem statement
    - Include discovery and documentation of approach to solve problem
    - Include sketched design concepts with critical features labeled
    - Critical dimensions clearly labeled in design sketch
    - Considerations for designing for additive manufacturing distinctly addressed (i.e. part strength, part orientation) especially including any expected risks during printing
    - Screenshots of the print time and material usage for all printed parts
    - Design decisions and alternatives are documented and evaluated thoughtfully

Presentation Criteria

- The team clearly describes their understanding of the problem to be solved.
- Design Process: good design logic is used for key design choices was intentional and well-communicated
- The presentation is professional and well-rehearsed
- Practical evaluation
- Teams may use a laptop to assist with the presentation, though not required.

SkillsUSA 2023 Additive Manufacturing State Challenge

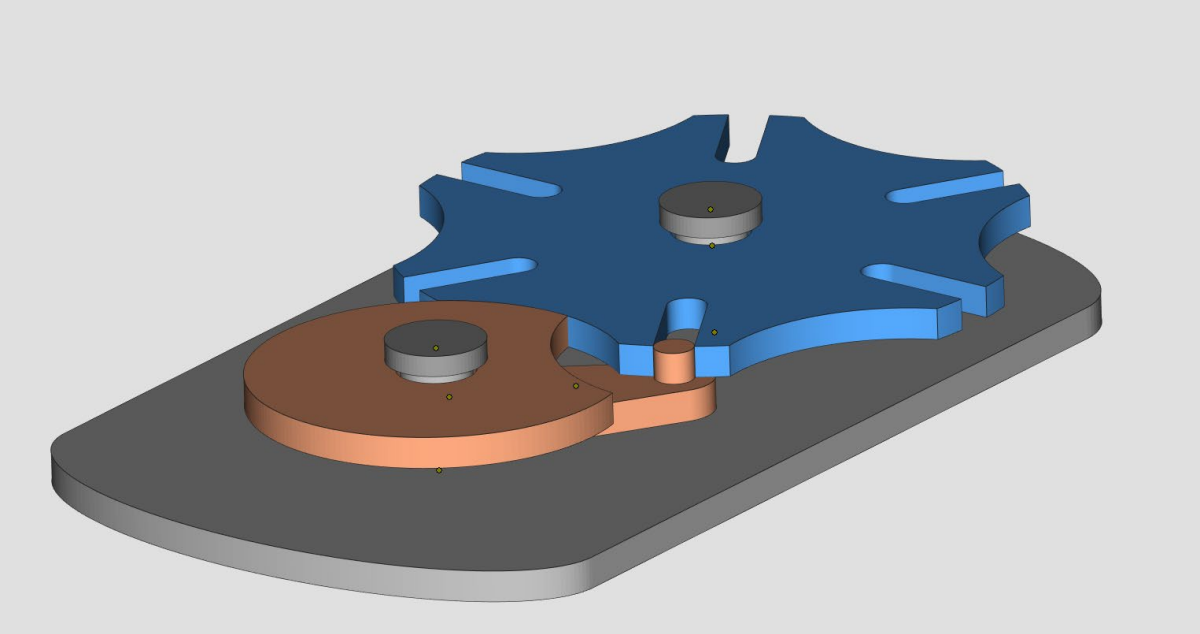
Kinematic Assembly Models

Welcome to the “Kinematic Assembly Models” challenge!

The task at hand is to design a functional/movable assembly, also known as a gear system, or kinematic model.

Examples of this type if system are below, this should help get you started on an idea:

- Peristaltic Pump
- Geneva Gear
- Rack and Pinion
- Differential
- Planetary Gear
- Bearing



Example of a functional assembly for reference only

Competition Requirements

1. The design **must** contain at least 3 individual bodies to be printed assembled or to be assembled after printing.
2. Printed parts **must** be able to mate and stay together by design or additional hardware provided by the contestant.
3. The design **must** contain at least two printed moving parts in the assembly.
4. One printed part's motion **must** be directly driven by another printed part's motion.
5. The printed parts **must** be able to mate together as an assembly, as designed, without major post-processing.
6. The design **must** be able to rotate/move as designed and should not have excessive backlash.
7. The design **can** contain additional store-bought hardware for the final assembly; this should be provided by the contestant and brought to judging.
8. 3D Printed Design - Students **must** create a design that:
    - Is original and designed by a contestant
    - Prints all parts in less than 18 hours
    - Uses less than 60 cubic inches (1kg) of model and/or support combined for all parts

Tips for Competitors

Here are some tips to maximize the points awarded to you:

- Be sure to design using the correct tolerance between printed parts to allow motion of assembly.
- Be creative by incorporating an end-use for the design.
- Additional moving parts may add to your score but can produce more points of failure on the final assembly.
- Try to leverage design for 3D technology to reduce the amount of additional hardware needed for final assembly.
- Use online resources (YouTube, GrabCAD Tutorials, Cornell's Kinematic Models for Design)
- Whenever intellectual property (IP) deters you from a project, try using approximate geometries to communicate the design intent
- Solve a problem that impacts multiple people
- Optional design for additive manufacturing learning resources:
    - Stratasys Think Additively™ Masterclass:
        - https://youtube.com/playlist?list=PLUYaY5EIPtNBdU-s-7l9rl05lBHHlTarl

State Competition Judging Criteria

1. The Engineering Notebook should contain robust content, including at a minimum the following:
1.1. Be clearly labeled with contestant name(s), date and page # on each page
1.2. Begin with a problem statement
1.3. Include discovery and documentation of approach to solve problem
1.4. Include sketched design concepts with critical features labeled
1.5. Critical dimensions clearly labeled in design sketch
1.6. Considerations for designing for additive manufacturing distinctly addressed (i.e. part strength, part orientation) especially including any expected risks during printing
1.7. Screenshots of the print time and material usage for all printed parts
1.8. Design decisions and alternatives are documented and evaluated thoughtfully

2. The design must adhere to the Competition Requirements stated in the prior page.

3. Quality of final assembly
3.1. Does it perform the function in the manner it was designed to do?
3.2. Does it meet all requirements in contest guidelines?
3.3. Do inserted components or multiple printed parts mate together properly?
3.4. Did the students design the part with additive manufacturing in mind?
3.5. Is there sufficient tolerance between parts for movement?

4. The design must illustrate best practices for “design for additive manufacturing (DFAM)”. Below are some potential DFAM metrics to optimize for.
4.1. Build Time
4.2. Post-Processing/Support Removal Time
4.3. Functionality Optimization (gear ratio, pliability, strength, etc.)
4.4. Monetary Savings
4.5. Material Consumption
4.6. Energy Usage
4.7. Component Consolidation (lack of store-bought hardware)
4.8. Lightweighting for Ergonomics

5. Presentation Criteria
5.1. The team clearly describes their understanding of the problem to be solved.
5.2. Design Process: good design logic is used for key design choices. Intentional and well-communicated
5.3. The presentation is professional and well-rehearsed

5.4. The presentation emphasizes quantitative improvements (measured and estimated) of the time, quality, or cost of the improvement as well as any DFAM tactics employed.
5.5. Practical evaluation: team demonstrates visually (videos, photos, drawings, animation, etc) the task they improved, both before and after.

Additive Scorecard:

Additive Manufacturing Scorecard

		Contestant Number									
Items Evaluated	Possible Points	1	2	3	4	5	6	7	8	9	10
Original Design											
Fit, Form & Function	40										
Durability of Design	40										
Contest guidelines adherance	40										
Reverse Engineering of complex details displayed	40										
finishing & aesthetics of 3D printed component(s)	100										
Modification On-site											
No onsite modifications required	220										
Engineering Portfolio											
concept description	45										
slicing softw are parameters explained	45										
dimensional and tolerance drawings	45										
reverse engineering design process explained	45										
other relevant information/documentation	20										
finishing aspects that impact design	20										
mistakes and/or any lessons learned	40										
Presentation											
problem statement explained	40										
engineering design process explained	40										
RE component design described	30										
professionalism / clear communication	30										
Knowledge Exam	100										
20 questions, 5 points/question											
Skills Assessment	20										
Demonstrate precision measurement instrument skills											
Résumé Penalty	0 or -10 only										
Clothing Penalty	0 or -50 only										
Time Penalty	0 or -50 only										
Team Penalty (if competing with less than the required number of team members)	-100										
Total Possible Points	1,000										

For questions pertaining to the competition, please contact Oliver Johnson (ojohnson@spsd.net) or Gregg Zydeck (gzydeck@atctrain.com).