TA201A: Manufacturing Processes-I

PROJECT TITLE- SUBMARINE

SECTION- 3
GROUP- 3
TUTOR- DR. KANTESH BALANI

Introduction

We have created a model of submarine which is an important warship. It is designed to operate completely submerged in sea for long periods.

Our model uses 2 mechanisms. The hydroplane mechanism and the propeller mechanism. These are used for steering the submarine and propelling it forward respectively.

Our model is 50 cm in length and an overall 14 cm in height and breadth is 17cm. It weighs approximately 3.5 kgs.

Motivation

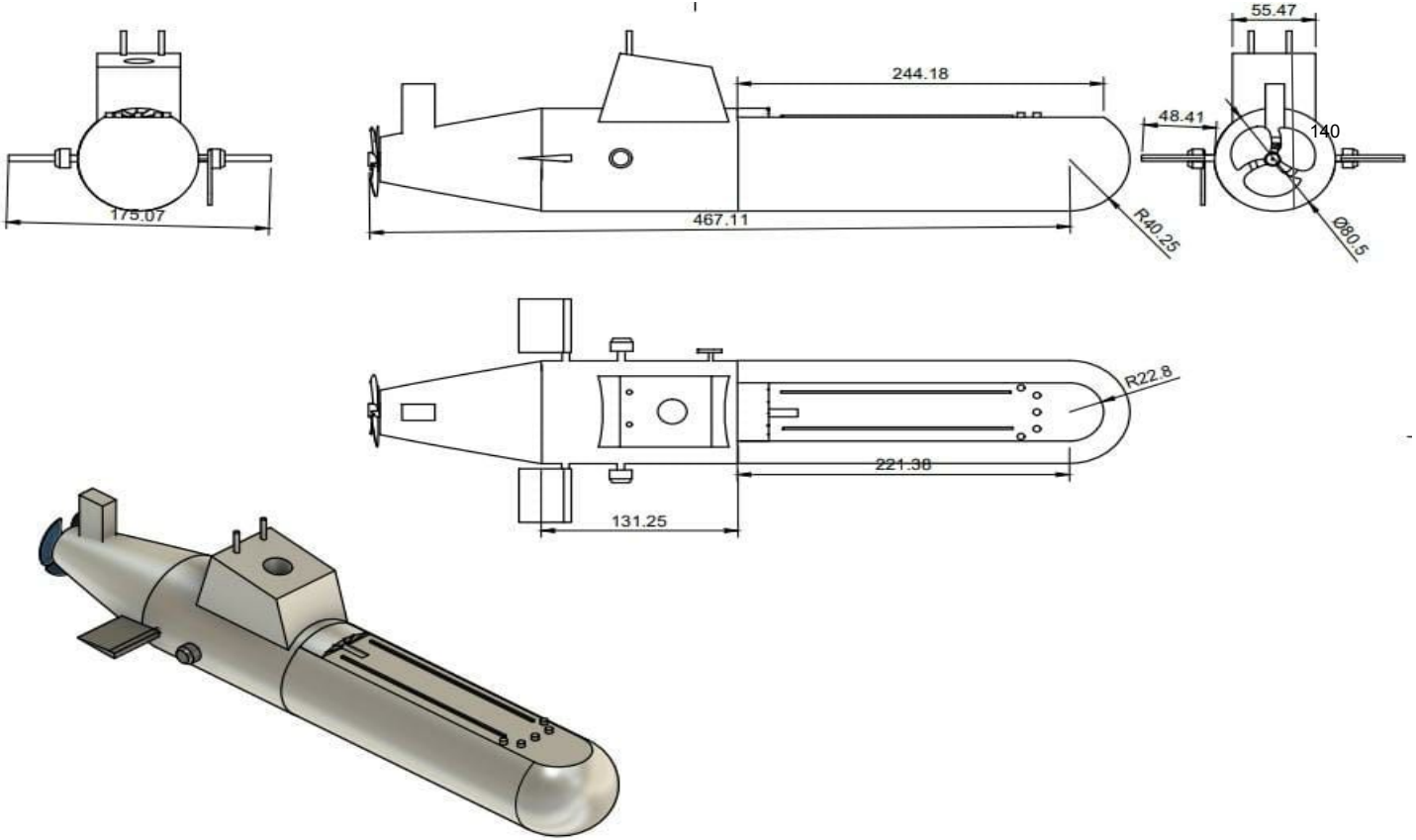
We wanted to create a scalable model of a submarine showing its design and its components.It includes propellers which will be manually operated through a pedal,and the wing which are used in the diving and surfacing of the submarine are operated through a knob.

We have learnt about materials and and manufacturing processes in TA201. Thus, we got the opportunity to idealise a model based on the theoretical aspect of this course.

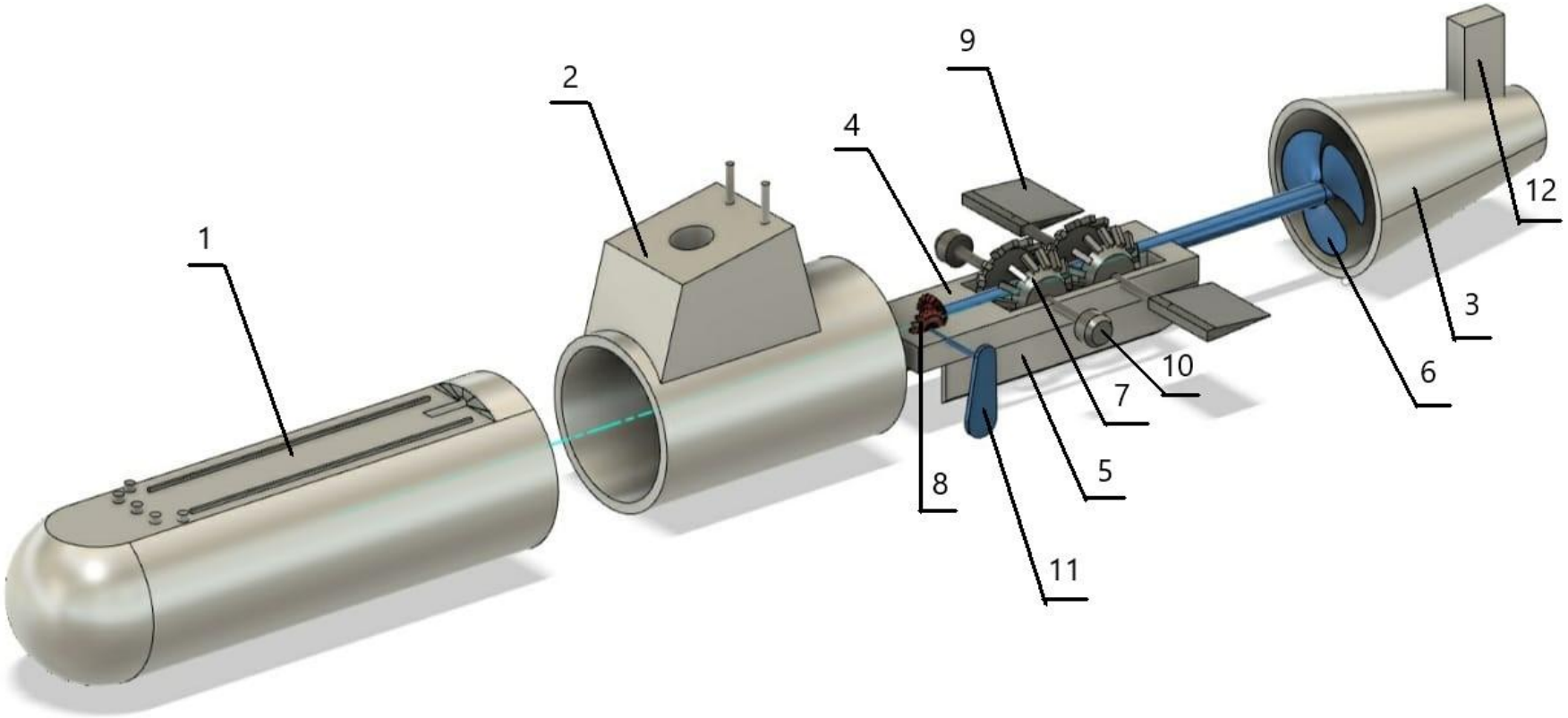
Work distribution

		Turn 1	Turn 2	Turn 3	Turn 4	Turn 5
200296	Chikoti Shreenaga Tejas	Ideas and discussion	Working on CAD designs	Mainframe, platform integration	Mainframe and platform drawing	Working on CAD design and its improvement based on feedback
200213	Ashu Pal			Rudder hydroplane editing & animation	Rudder hydroplane component drawing	
200534	Kunal Nayak			Propeller mechanism animation	Pedal and joining rod drawing and editing	
200735	Priyanshu Maurya		Suggesting and discussing improvements in design based on feedback	Propeller and knob	Propeller and propeller mechanism drawing, manufacturing details, ppt editing	Ppt editing and cost analysis table
201071	Uttam Kumar			Gear	Disc and belt manufacturing detail	Manufacturing process
200575	Md Aakib Alam Ansari			Platform and mainframe	Manufacturing details of mainframe and platform	
200178	April Samad			Pedal	Manufacturing details	
200586	Modem Sai Charan			Gear	Bevel gear drawing, manufacturing details	

Final picture



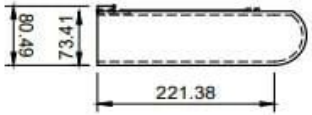
Exploded view

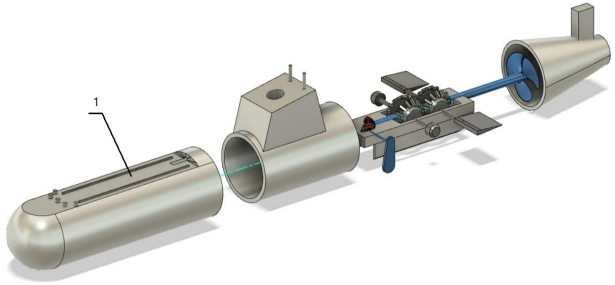


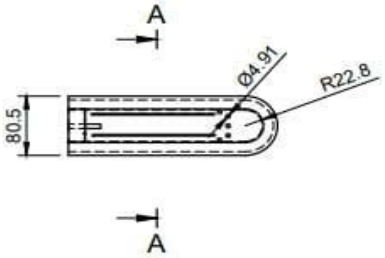
Components

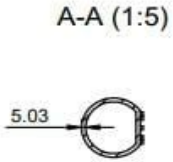
	Component	Material	Quantity
1	Front frame	Cast Iron	1
2	Middle part	Cast Iron	1
3	End part	Cast Iron	1
4	Platform	Cast Iron	1
5	Support for platform	Cast Iron	1
		Mild steel sheet (2 mm)	
6	Propeller	Aluminium	1
7	Spur gear	Cast Iron	4
8	Bevel gear	Cast Iron	2
9	Wing	Cast Iron	2
10	Knob for rotating wings	Cast iron	2
11	Pedal	Cast iron	1
12	Rudder	Cast Iron	1
13	Rods	Mild steel rod (10 mm)	2
		Mild steel rod (5 mm)	4

Front frame





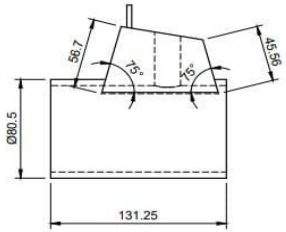


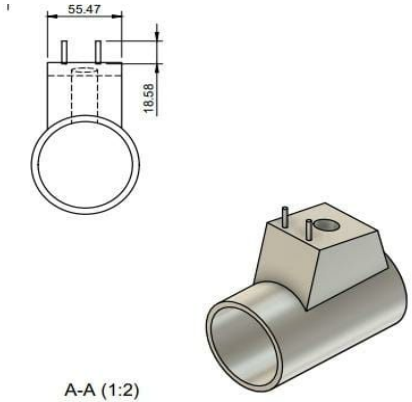


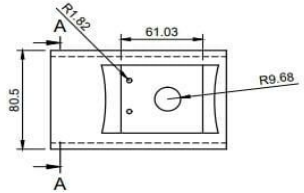
- Material used: Cast iron
- It is the front part of the body of the submarine.
- Manufacturing process : Casting
- Joining process : Welding

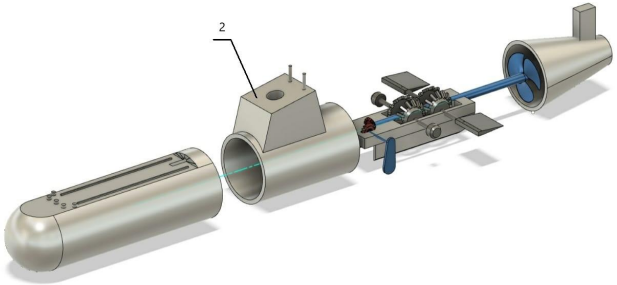
Its shape is actually an unsymmetrically cut hemisphere

Middle frame





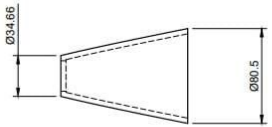


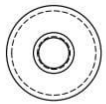


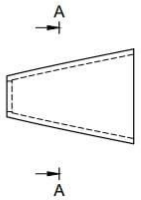
- Material used: Cast iron
- It is the middle part of the body of the submarine.
- Manufacturing process : Casting
- Joining Process: Welding

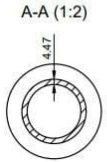
Upper rectangular block will be made separately by casting with a hole in it. The lower cylinder will be made separately by casting Both of them will be joined together by brazing.

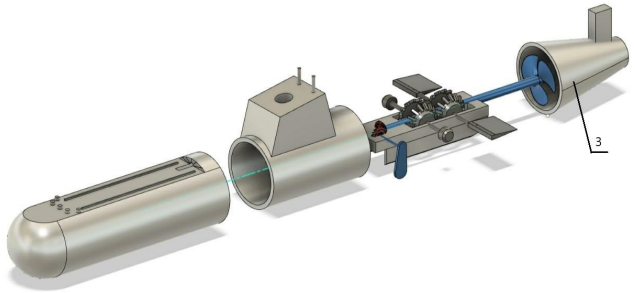
Rear frame





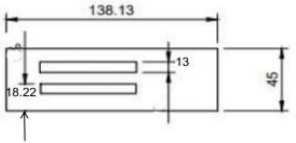


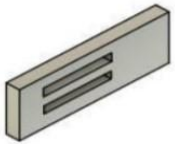


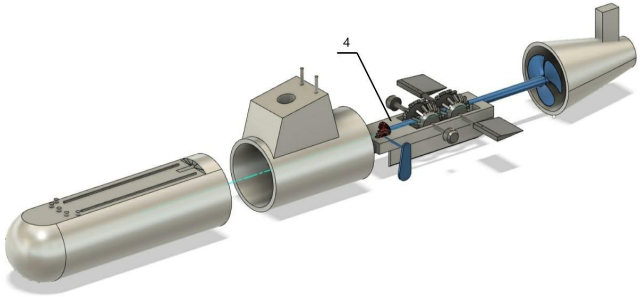


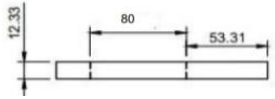
- Material used: Cast iron
- It is the rear part of the body of the submarine.
- Manufacturing process : Casting
- Joining process : Welding

Platform base



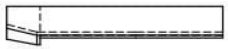


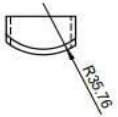


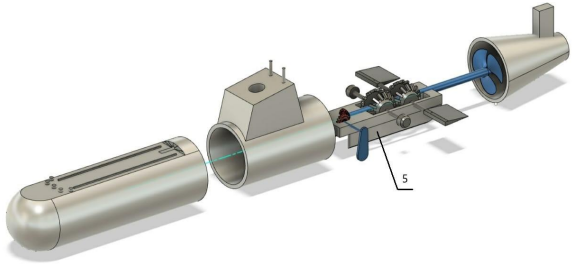


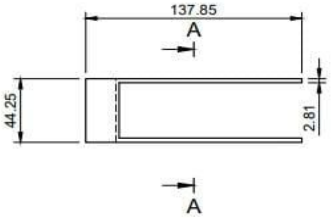
- Material used : Cast Iron
- It will be used for placing gears inside the submarine.
- Manufacturing process : Casting
- Joining process : Welding

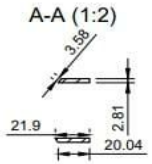
Support for platform

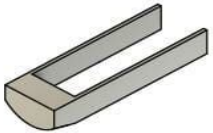








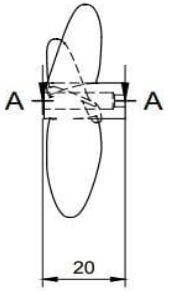


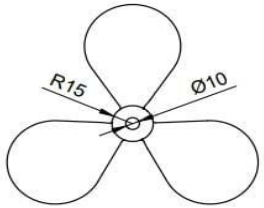


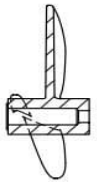
- Material used: Cast iron
- Joining process: Welding
- The frontal solid part will be made through sand mould casting,
- And the two rectangular sheet metal will be joined to it via welding.

This support is welded inside the submarine, and the platform along with gears will be welded to this support.The solid part of this will be made using casting and the sheets will be attached separately with brazing or welding.

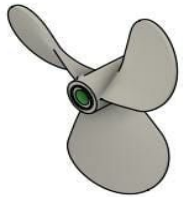
Propeller

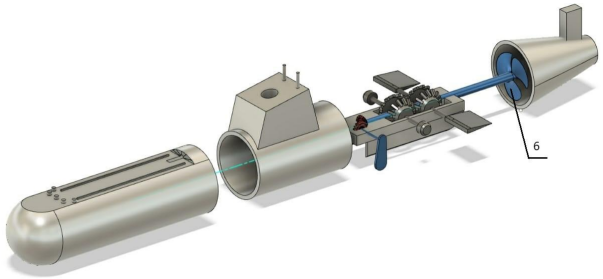






A-A (1:3)



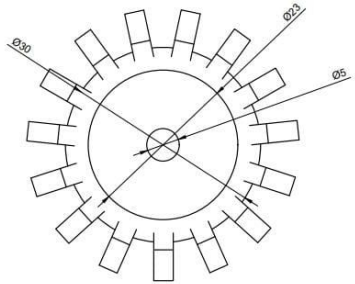


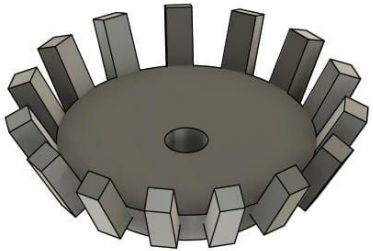
Thickness of blades : 3mm
Overall diameter : 8 cm approx

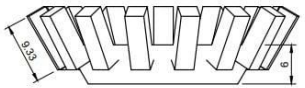
- Material used : Aluminium
- Propeller will be used to drive the the submarine through water.
- Manufacturing process：Casting
- Joining process：After inserting the mild steel rod into the hub of the propeller, the joint will be soldered to remove any gaps and give strength to the joint.

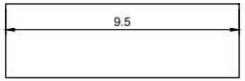
The curvature of blades will be made by shaping the thermocol separately and attaching them to the hub as visible in the isometric view.

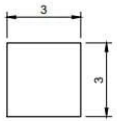
Spur gear

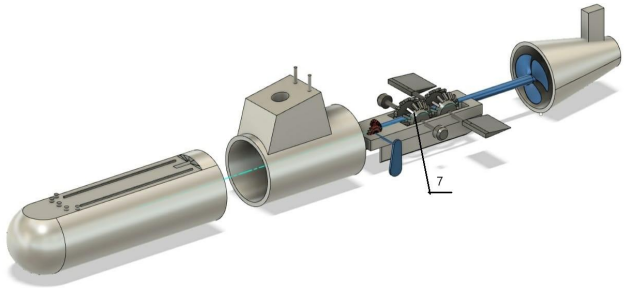








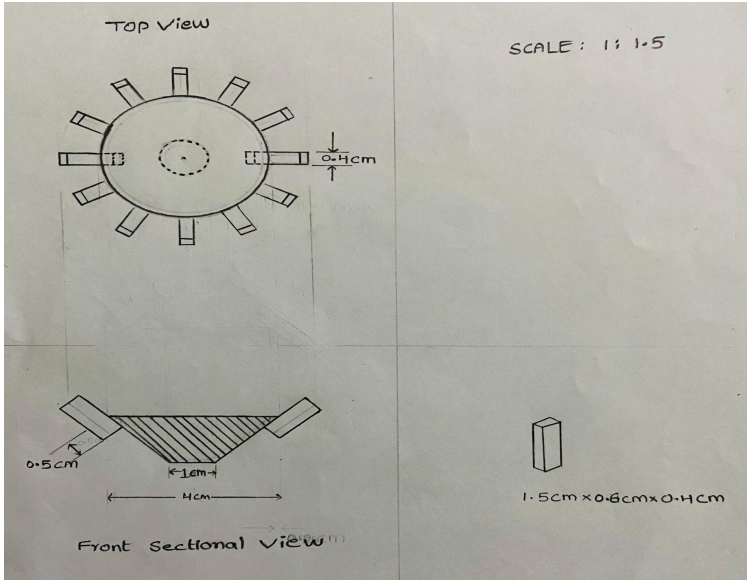


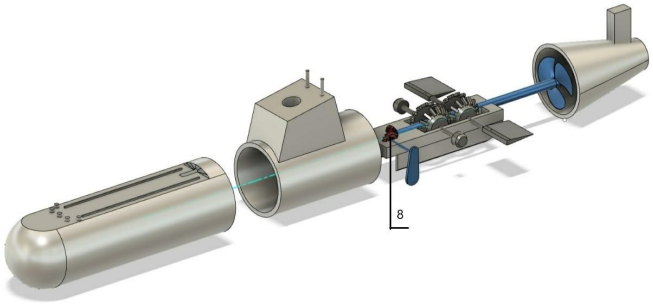


- Quantity : 4
- Number of teeths : 15
- Material Used : Cast iron
- Spur gears form the integral component of hydroplane mechanism. They will be connected on either side in pair.
- Manufacturing process : Casting
- Joining process: Brazing/soldering

We will use sand mould casting for manufacturing the disc like shape of gear and also for the teeth (15) which will be made separately. We will use brazing/soldering for attaching teeth to the disc of the gear.

Bevel gear

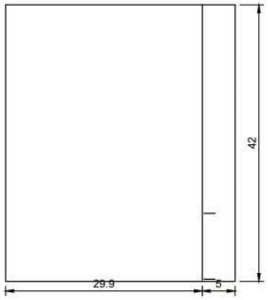


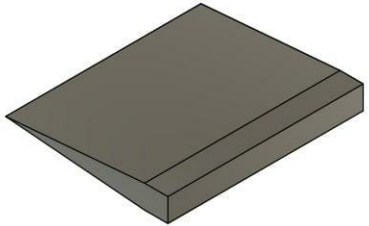


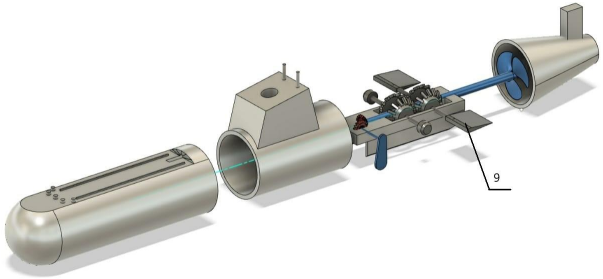
- Quantity : 2
- Number of teeths : 12
- Material Used : iron
- Bevel gears form the integral component of propeller mechanism. They will be attached perpendicular to each other.
- Manufacturing process : Casting
- Joining process: Brazing/soldering

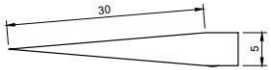
We will use sand mould casting for manufacturing the frustum of gear and also for the teeth (12) which will be made separately. We will use brazing/soldering for attaching teeth to the disc of the gear.

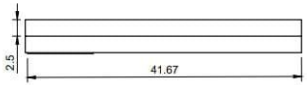
Wing







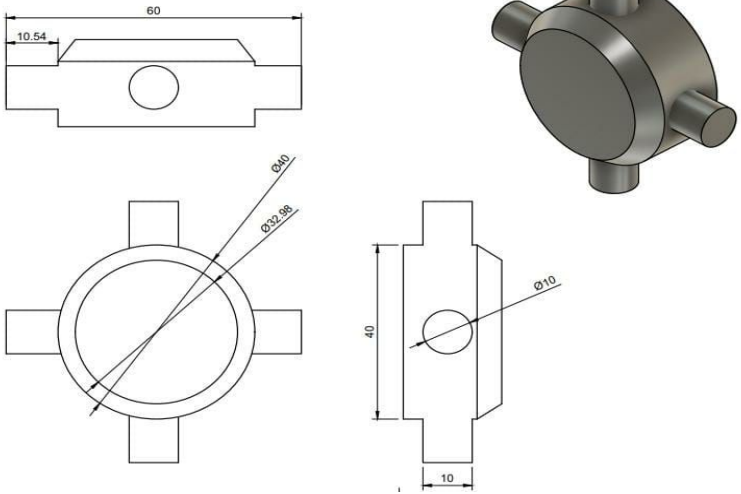


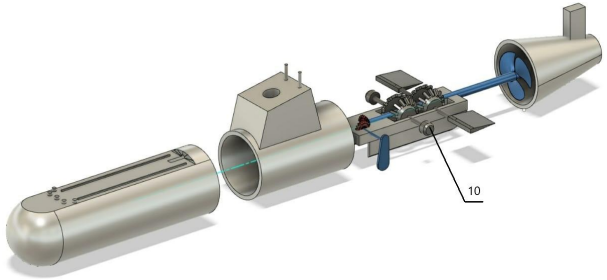


- Quantity : 2
- Material used: Cast Iron
- These will be used to change direction.
- Manufacturing process : Casting, rolling/forging
- Joining process : Welding

After the process of casting , rolling is carried out to give its shape.

Knob for rotating wings

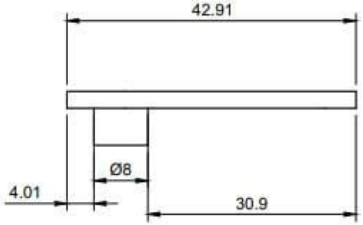


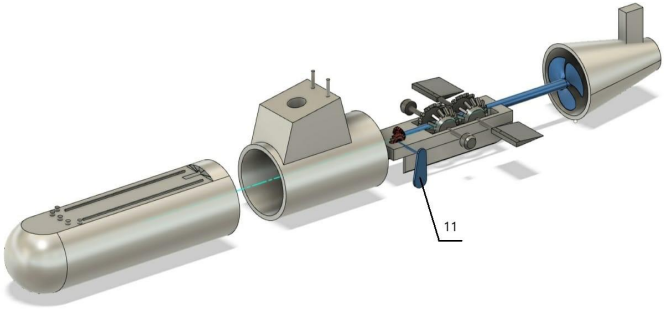


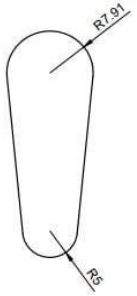
- Quantity : 2
- Material used:Iron
- These will used to rotate the wings.
- Manufacturing process : Casting, extrusion
- Joining process : Welding

Cylindrical object will be formed by casting. Now, extrusion process is carried out to give the original shape.

Pedal

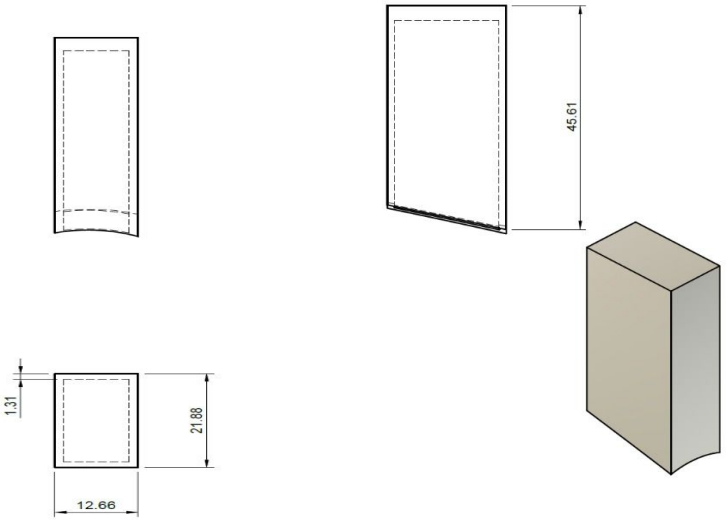


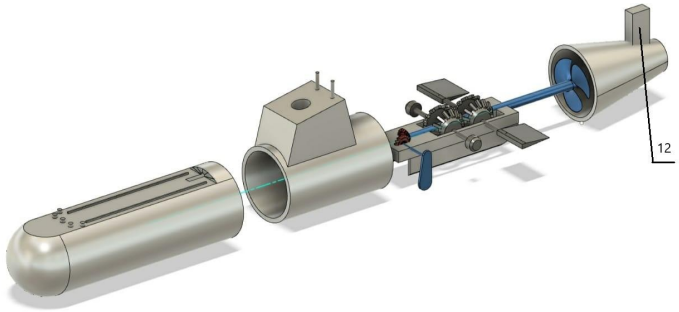




- Material used : Cast Iron
- Pedal provides connection between external work and the bevel gear via mild steel rod.
- Manufacturing process : Casting
- Joining process : Welding

Rudder





- Material used : Cast Iron
- Joining process : Welding
- Manufacturing process : Casting

Joining rods

Rod for joining propeller with bevel gear :

Mild steel rod (10 mm) L= 209 mm

Rod for joining pedal with bevel gear :

Mild steel rod (10 mm) L = 37 mm

Rod for joining wing with disc (2) :

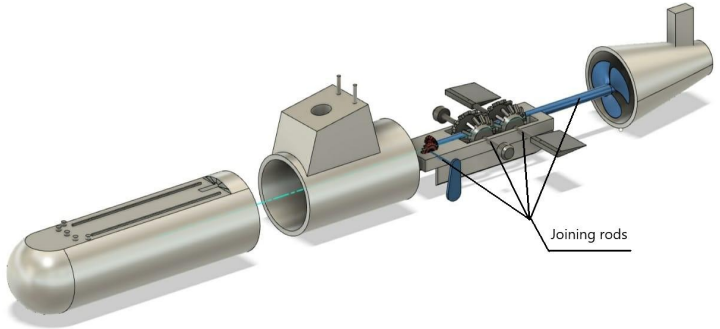
Mild steel rod (5 mm) L = 30 mm

Rod for joining knob with disc (2) :

Mild steel rod (5 mm) L = 30 mm

Manufacturing process : Cutting

Joining process : Welding

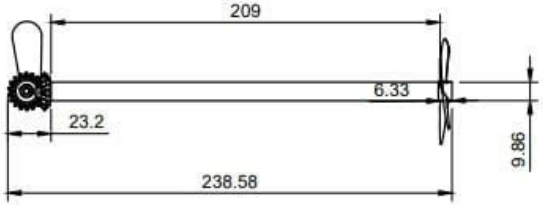


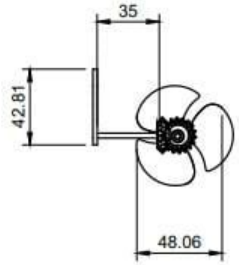
Cost analysis

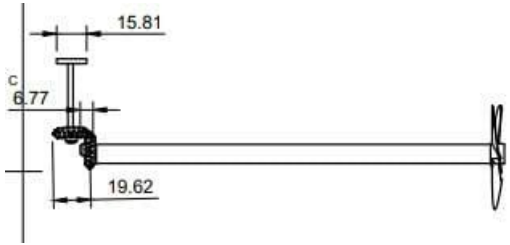
	Component	Material	Weight (grams)	Cost (Rs)
1	Front frame	Cast Iron	325	117
2	Middle part	Cast Iron	157	
3	End part	Cast Iron	580	
4	Platform	Cast Iron	470	
5	Support for platform	Cast Iron	244	19
		Mild steel sheet (2 mm)	92 (Area = 24 cm^2)	5
6	Propeller	Aluminium	71	27
7	Spur gear(4)	Cast Iron	53 × 4 = 212	91
8	Bevel gear(2)	Cast Iron	82 × 2 = 164	
9	Wing(2)	Cast Iron	53 × 2 = 106	
10	Knob for rotating wings(2)	Cast iron	181 × 2 = 362	
11	Pedal	Cast iron	248	
12	Rudder	Cast Iron	91	
13	Rods	Mild steel rod (10 mm)	158	11
		Mild steel rod (5 mm)	184	13
Total			3464 grams	Rs. 283

Man hour required : 25 hrs approximately

Propeller mechanism







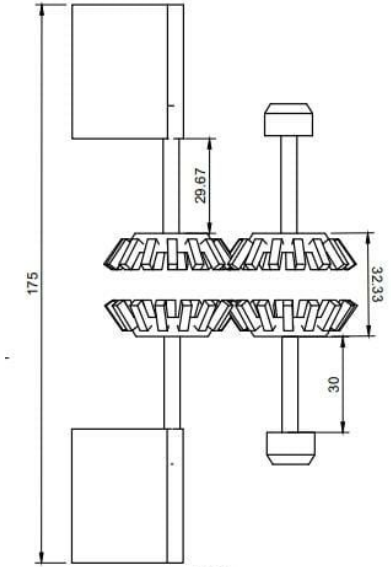
Through propeller mechanism, we move our submarine forward.

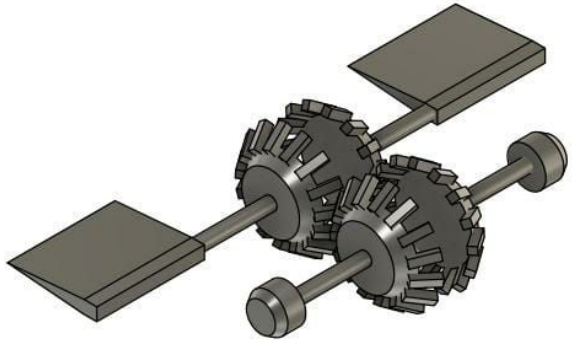
We rotate the pedal mechanically, in this way the bevel gear moves.

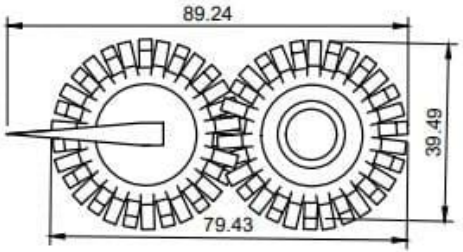
It causes another bevel gear at 90 degree to rotate which in turn causes propeller to rotate.

Thus, it propels the submarine forward.

Hydroplane mechanism





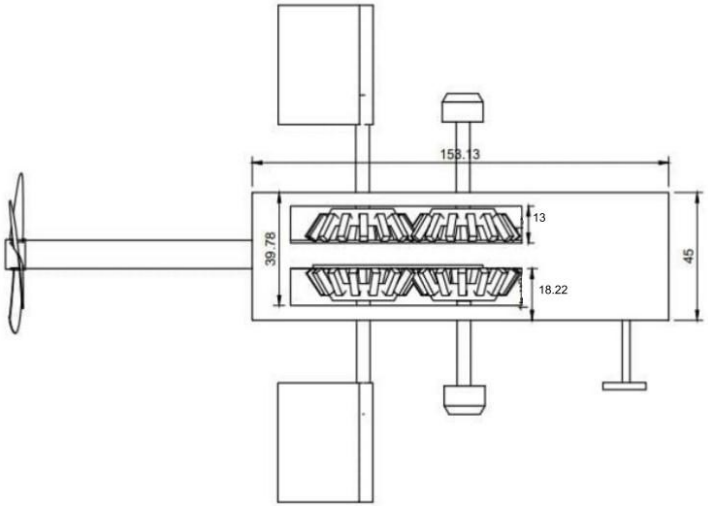


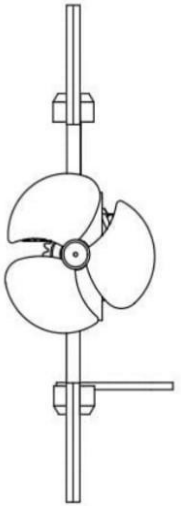
Through hydroplane mechanism, we change direction of movement of the submarine.

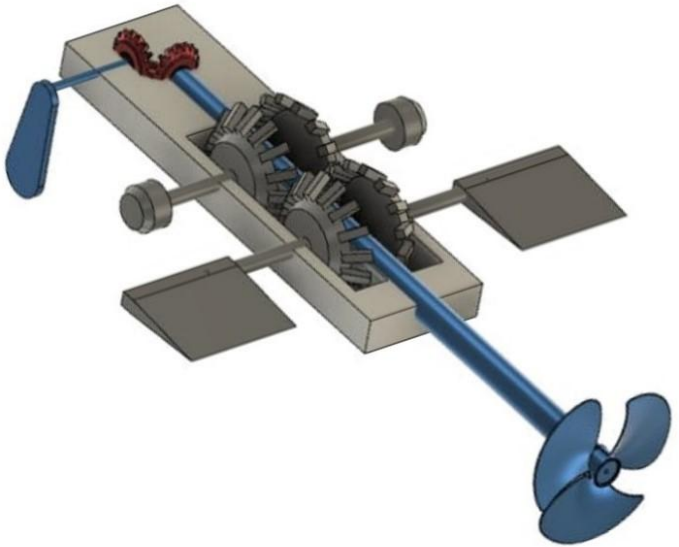
We rotate the knob mechanically which causes spur gears to rotate.

This causes movement of wings either up or down which would change the direction.

Assembly of hydroplane and propeller mechanism on platform







Challenges faced and improvements possible

Challenges faced:

It is difficult to manufacture gears, one due to teeth size and the complexity involve. That’s why we created custom gears i.e. disc and the teeth separately and join the teeth to the disc by brazing. Those are the bevel gear and the spur gear.

Improvements possible:

1. We could create a mechanised rudder that is movable.
2. A central movement system that will move both the stern planes simultaneously.
3. Create a compartment which can control the flow of water inside the submarine which will allow it to submerge.

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We are grateful to Dr. Shashank Shekhar, course instructor for providing us with this opportunity to get an experience of the lab component of the course through online mode. We would like to express our sincere gratitude to our tutor Dr. Kantesh Balani, lab incharge Mr. Anil Kumar Verma, the TAs Arijit Samaddar and Shalini Kushwaha for their valuable feedback and constructive criticism during planning and development of this project without whom this would not have been possible.