Mahatma Education Society's

Pillai College of Engineering, New Panvel

REPORT ON MINI-PROJECT-1B (MEPBL401 & AEPBL401)

Department of Mechanical and Automobile Engineering

2020 - 2021

CLASS: SECOND YEAR **SEMESTER:** IV **SCHEME:** R2019 (REVISED C SCHEME)

The Revised 'C' scheme (R2019) formally took effect for second year engineering students of Mechanical and Automobile engineering departments of Mumbai University this year (2020-2021), and the Project Based Learning (PBL) which was introduced in our institute in the academic year 2016-2017 and running successfully as an added course to cater to the enhanced learning of the students, was inducted as a separate mandatory course in the syllabus, under the name: **Mini-Project-1B**. This report highlights the summary of the course conducted in the semester IV of the present academic year.

Students were instructed at the start of the semester, to form groups of 3-4 students each for the mini project. They were shortly later introduced to the topics. 3 topics were floated and students were instructed to select one of them. Ample time of about a week was given to identify their choice. Since the lockdown was in effect due to the deadly coronavirus pandemic, topics were to be identified to enable the students to work comfortably from their homes.

The three topics identified and floated to the students, are titled as follows:

Topic 1-Liquid Pouring Mechanism

Topic 2-Tree Climbing Unit

Topic 3-Pick & Place Unit

Following the advice from the experts framing the syllabus, one topic (Topic 1) was floated related to problem solution for a social cause, to help the old and physically weak persons including children, to pour liquid onto a container from a large bottle. To aid the students in selecting their topic of interest, a separate orientation program was organised through online Google Meet, wherein the topics were discussed in detail and students' queries answered.

The **problem statements** related to the **three topics** are as follows:

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Topic 1: LIQUID POURING MECHANISM

The Scope:

Liquid pouring mechanism is aimed to assist the physically weak human population (viz., the elderly and those with body ailments), children etc. to hold a large bottle/flask and pour liquid onto a container (cup, glass etc.) comfortably and safely.

Objectives:

1. Students are required to devise and construct a workable mechanism that should be able to hold a large 2.5 litre PET bottle filled with liquid, and also hold a container (glass, cup or similar) at a convenient location.
2. The mechanism when operated by a hand (single stroke only) should tilt the bottle and pour the required amount of liquid onto the container.
3. The PET bottle and container may have relative motion (linear/angular or both) with respect to each other.
4. When the hand is released, the mechanism is supposed to come to its initial position on its own, neither disengaging the bottle nor the container during the process.
5. Provision should be made in the mechanism for easy removal of both the PET bottle and the container whenever needed.

Additional Information:

1. The unit is to be mounted on the top of a table (approximately 70 – 75 cm from the ground) for use.
2. The bottle cap should be removed prior to pouring liquid from the bottle, and no device (such as nozzle etc.) is allowed to be attached to the open end while pouring.
3. Any combination of engineering materials and used/scrap parts may be used for constructing the unit.
4. As various product designs (specifications) are available for different brands of PET bottles in market, there is no specific shape of bottle to be held. Same is true for the containers. Students should ensure that all possible brands of PET bottles of 2.5 litre capacity and shapes of all possible containers in general (for drinking purposes—about 200 to 250 ml capacity), may be fit for use in the mechanism.
5. Students may bring their own PET bottle and container during demonstration, the specifications of which may be used for their design. Note that the shapes of the bottle and container to be used are a matter of choice.
6. Drawing initial rough sketches of the possible mechanisms is an important phase in the conceptualization of the mechanism and hence in the design process. Students should submit sketches (freehand) of 3-4 possible mechanisms, discuss relative merits and demerits of each, and document the same for continuous evaluation by the judges/evaluators. Finally, they should arrive at a final selection of mechanism.
7. The mechanism finally selected should preferably be modeled in any 3D software (parts and assembly), and its motion simulated (animation).
8. Using concepts learnt in theory, students should be able to analyze the motion characteristics of the links of the mechanism, and calculate the effort (force/moment) required to operate the mechanism.
9. Students may supplement the use of devices learnt in 'Industrial Electronics' subject for aiding their mechanism for attaining the required action.
10. A well documented manual consisting of various stages of design is to be submitted on or before the date of final demonstration.
11. Emphasis shall be given on the work which is ingenious. Also, the mechanism is expected to be very light in weight (portability requirements). And, timely completion of the various stages of design process will be rewarded with better grades.
12. As usual, the PBL work shall be evaluated in 2 stages—a mid-term, and at the end of the semester.
13. **Student groups MUST maintain a well maintained LOG BOOK to record the daily/weekly activities related to the project. The same shall be submitted along with the report at the end of the course, and you may be required to furnish during your mid-term and final evaluations too.**

Precautions:

1. The bottle and container should be held firmly in the mechanism, without getting dropped (stability requirement) at any stage during operation.
2. Possibility of spilling of liquid while getting poured in the container should be minimized as far as possible.
3. The mechanism is not supposed to cause undue harm at any stage during the operation, failing which may lead to disqualification.

Dates for Evaluation: (mid-term & final) *Shall be intimated accordingly in due course of time. Tentatively, the dates are mid-March and mid-April respectively.*

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Class: Second Year **Semester:** IV CBCGS

Topics 2 & 3: TREE CLIMBING UNIT & PICK-&-PLACE UNIT

Learning Outcomes:

At the end of the Mini-project-1B course, students shall develop key skills in computer-programming, computer aided 3D modeling and animation, engineering technology (Kinematics & Physics concepts).

The Mini-Project is aimed to promote critical thinking, communication, collaboration & creativity, and to provide a foundation for data collection, analysis, presentation, and technical writing skills.

Objectives:

Students will explore the questions: "How do things move?" and "What is motion?". The goal of the topics 2 and 3 of the mini-project-1B is for students to develop kinematic concepts of motion and apply this knowledge to a design challenge. The design challenge is to build a device that must accomplish one of the following objectives:

(a). Topic 2: Move an unit vertically upwards.
Application: Tree-climbing unit.
or
(b). Topic 3: Move an unit horizontally.
Application: Pick-&-Place unit.

Through this investigation, students apply their understanding of kinematics and supplementary subjects to analyze motion by making measurements and calculations as well as exploring the need for transportation and logistics.

Requirements:

1. For both the topics mentioned above, it is mandatory for the students to use a mechanism consisting of at least 4 links to a maximum of 6 links only. The links can be of any type that are covered in the subject of Kinematics of Machinery, including fluid as a form of link, from Fluid Mechanics subject.
2. The input force/moment to drive the units for both the topics can be purely mechanical, or using some motor driven by battery.
3. The tree climbing unit (topic-2) should be able to carry a live load of at least 1 kg in addition to its self weight (dead load, consisting of the weight of all its attachments, links

etc. that comprise the unit). Similarly, the pick-&-place unit (topic-3) should be able to carry a live load (a cuboid) of at least 1 kg from a location on the place surface of the ground, to a different location.

4. Both the units are supposed to move by a distance of at least 1 meter, in minimum amount of time.
5. Focus shall be on unique designs, with least number of design parts used (simplicity of design) for each case.
6. You are encouraged to use devices or concepts covered in the subject: Industrial Electronics in addition to the kinematic linkage mechanism.
7. Students will conduct research on feasibility, costs, history of the issue, current technologies in use (what is currently being done to address the issue), and explain how it connects to the principles of physics or kinematics or related subject/s.
8. In the brainstorming activity, students will select the best concept ideas, brainstorm with respect to the relative merits and demerits, check their objectives, and improve the ideas they selected to select the best possible idea with or without modifications. In the process, they are expected to create rough sketches of each concept idea, and the final idea generated after brainstorming.
9. The kinematic (motion characteristics) calculations should be done for a given input motion of the crank or motor, for all the links of the unit.
10. After finalization of the concept idea, computer aided 3D modeling of the final concept using preferable software of choice, along with animation of expected motion is to be done.
11. A well documented manual along with the log-book, is to be submitted for both the evaluations (mid-term and final). The minimum requirements for the mid-term assessment for the course project ends at this stage.
12. Following the computer modeling and animation, students are required to build working prototype of the concept model, using any combination of engineering materials and used/scrap parts as far as possible.
13. Emphasis shall be given on the work which is ingenious. Also, the mechanism is expected to be very light in weight (portability requirements). And, timely completion of the various stages of design process will be rewarded with better grades.
14. Students shall showcase their through a video – a working physical prototype, a technical display which includes an introduction to the problem being addressed, an explanation of the physics principles involved, the design specifications and technical drawings (include 3-view and isometric representations preferably CAD-rendered), the testing results and justifications of changes made to device (based on initial testing) if any.
15. **Student groups MUST maintain a well maintained LOG BOOK to record the daily/weekly activities related to the project. The same shall be submitted along with the report at the end of the course, and may be required to furnish during your mid-term and final evaluations too.**

Precautions:

1. The mechanism is not supposed to cause undue harm at any stage during the operation, failing which may lead to disqualification.

Dates for Evaluation: (mid-term & final) *Shall be intimated accordingly in due course of time. Tentatively, the dates are mid-March and mid-April respectively.*

The **number of student groups** in the respective classes and the **extent to which the topics were selected by each class**, is tabulated as follows:

CLASS	*No. of Groups selecting TOPIC 1*	*No. of Groups selecting TOPIC 2*	*No. of Groups selecting TOPIC 3*	*TOTAL No. of Groups in the Class*
SE MECH-A	11	-	4	**15**
SE MECH-B	15	-	6	**21**
SE AUTO	14	1	5	**20**

To monitor the performance of the student groups, there were 2 in-semester evaluations conducted by the faculty members of the departments. Similar rubrics were followed for all the three topics in general since they all deal with the development of a mechanism for some application. The **sample rubrics** framed for all the three topics are highlighted as follows, respectively for evaluations 1 and 2:

Sr. No.	RUBRIC	1	2	3	4	5	Marks Obtained
		0%	25%	50%	75%	100%	Out of 100 for each row below
		(Enter only number 1 in the particular cell below, for each row)					
1	Design concept ideas (in content i.e., 3-4 nos., and in relative uniqueness)					1	100
2	Determination of kinematic or motion parameters i.e., displacement, velocity and acceleration of all the links in the best mechanism using either ICR or Relative Velocity/Accln method (theoretical calculations)				1		75
3	Quality of 3D model of best mechanism using any modeling software and its motion simulation, and determination of motion parameters using software			1			50
4	Degree of correctness of theoretical and simulation results of motion parameters (Validation/Verification)		1				25
5	Submission and quality of documented report (pdf) including Log Book (pdf)		1				25
6	Quality of group-presentation during assessment (verbal / powerpoint) including gif/animation files or native 3D model files			1			50
	SAMPLE RUBRICS SHEET FOR ASSESSMENT-1	TOTAL MARKS OBTAINED (OUT OF 100):					54

Sr. No.	RUBRIC	1	2	3	4	5	Marks Obtained
		0%	25%	50%	75%	100%	Out of 100 for each row below
		(Enter only number 1 in the particular cell below, for Sr.Nos. 2-3 only)					
1	Performance of the group in Assessment-1						71
2	Quality of constructed 3D model (full or scaled-down version) of the mechanism					1	100
3	Quality of 3-5 minute video file (preferably .mpeg type) describing summary of entire mini-project, with narration and visuals					1	100
		TOTAL MARKS OBTAINED (OUT OF 100):					90

The students later had to appear for the viva-voce in the presence of Internal and External Examiners, as per the rules laid down by the Mumbai University.

It was observed that only one group had opted for the Topic 2 i.e., Tree Climbing Unit. Maximum number of groups selected Topic 1 for their work, and a decent few number of groups selected the Topic 3.

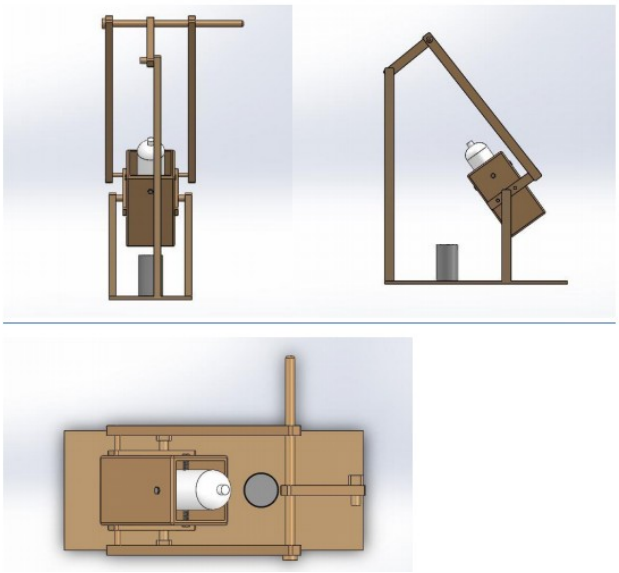
Students also submitted the source files of their project, along with a detailed report, and a Powerpoint presentation file, as a part of their term work. Also, some student groups managed to create the physical prototype of their concept idea, in addition to the simulation of mechanism and animation using SolidWorks or Autodesk Fusion 360 software, using the common materials in day-to-day home use, or from links from some toy set such as Mechanix etc.

Students were also advised to record their entire mini-project-1B work in the form of a 3-5 minute video and suitably edit it if possible, so that it would enhance their video making and editing skills too. They were also advised during the orientation program at the start of the project work, to consider planning effectively using any ready-made template of Log Book, many of which are available free to download from the internet.

Most student groups took the advice on a positive note and created wonderful 3-5 minute videos of their work, along with the Log Book. To conclude, in spite of the difficulties posed by the pandemic and work cornered through homes, students managed to work on their mini-project topic and got to learn the technical knowledge related to the subject/s, team building and management, effective communication, presentation (written and verbal), report writing, scheduling, delegation, costing etc. In this semester, they even managed to create beautiful videos with editing, and also maintained the Log Book to plan for the important events.

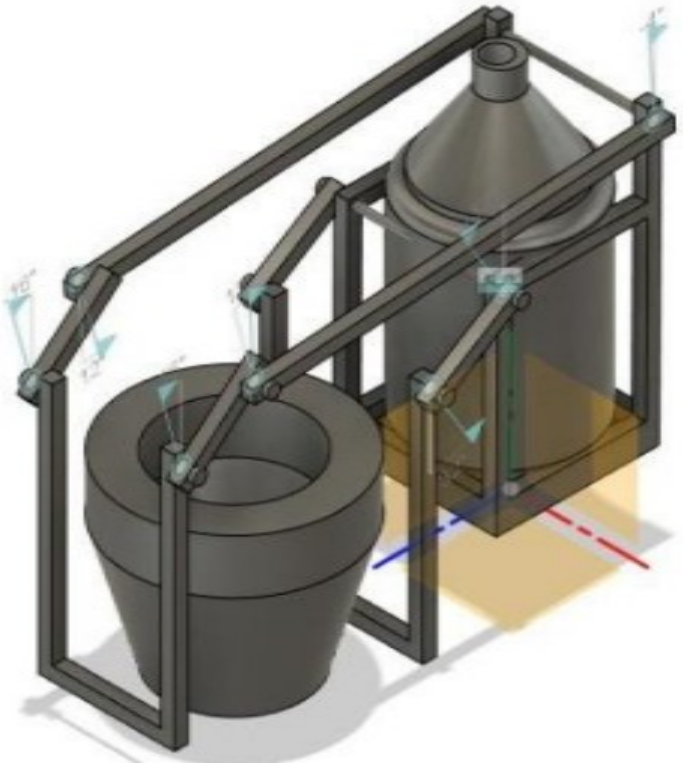
Sample work and a few snapshots of Mini-Project-1B taken during the evaluation stages or from the student reports, are provided for reference, as follows.

Few Sample Student-group Works:



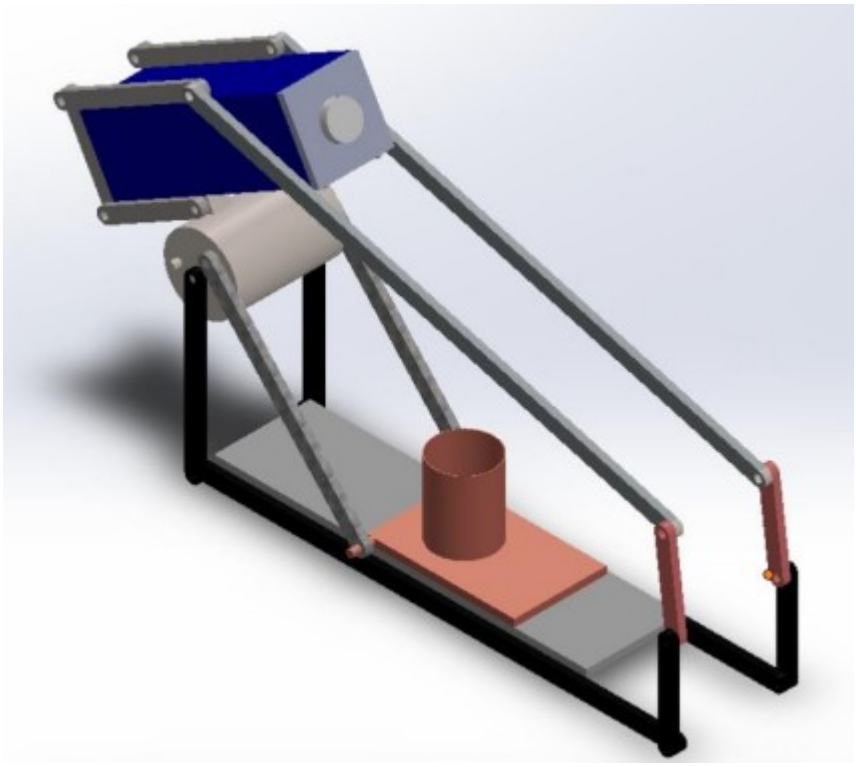
By Shivam Chavan and Group, SE Mech-B

Liquid Pouring Mechanism – Topic 1



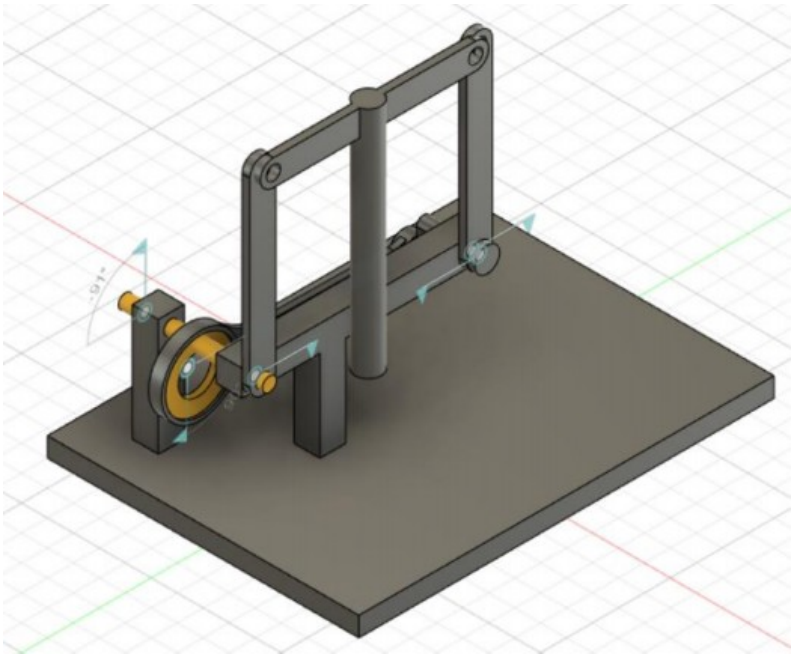
By Rohit Jain and Group, SE Automobile

Liquid Pouring Mechanism – Topic 1



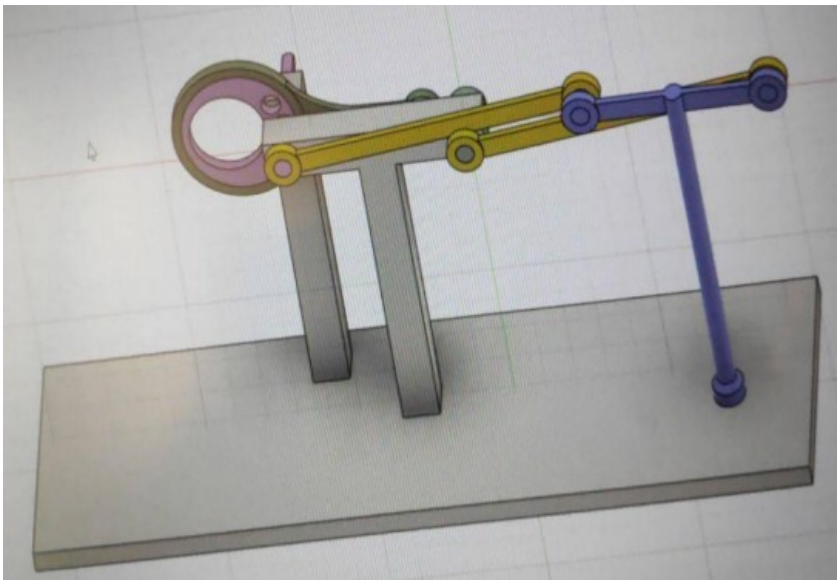
By Saurav Parappurath and Group, SE Mech-B

Liquid Pouring Mechanism – Topic 1



By Vansh Chamoli and Group, SE Mech-A

Pick & Place Unit (Horizontal) – Topic 3



By Vishak Vinukumar and Group, SE Automobile

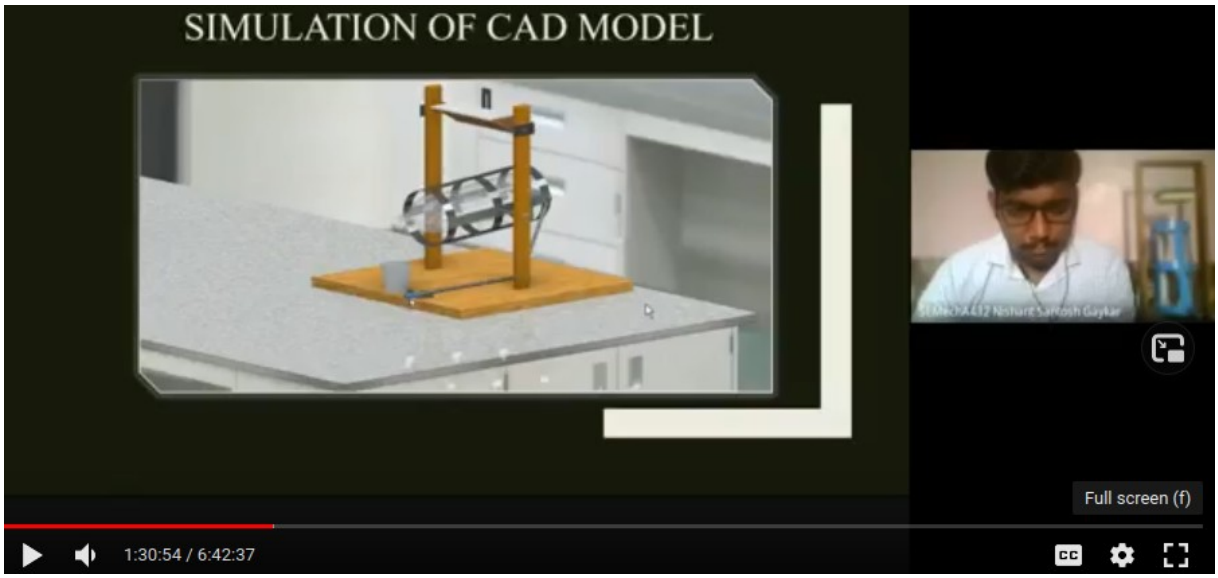
Pick & Place Unit (Horizontal) – Topic 3

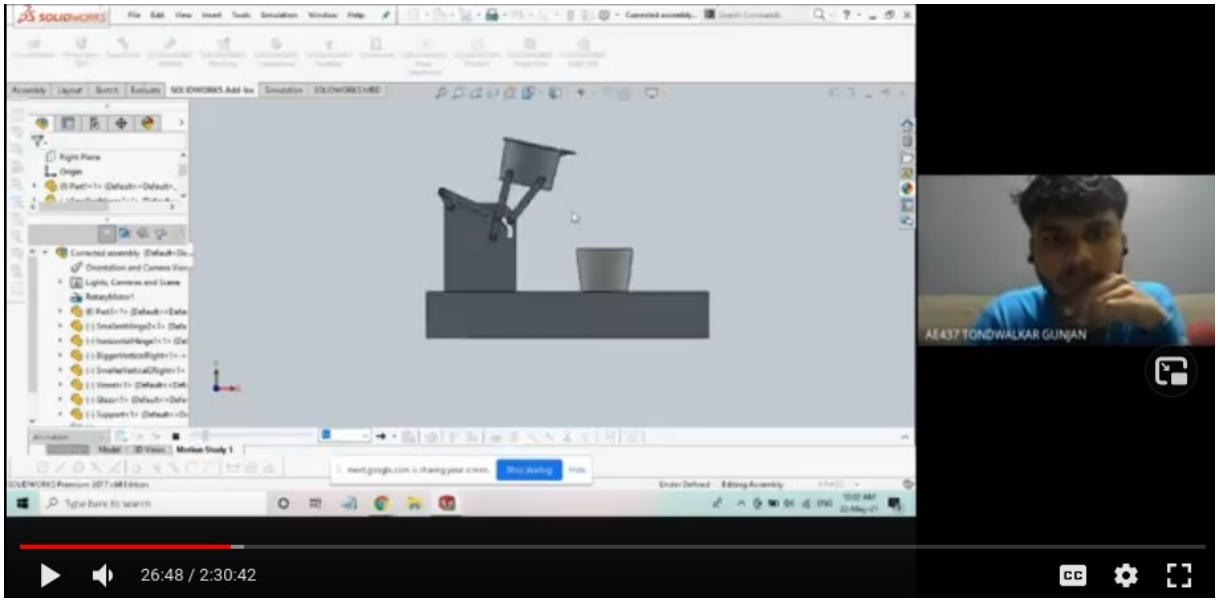
Left: Mechanix – Toy set consisting of links, used for creating the prototype

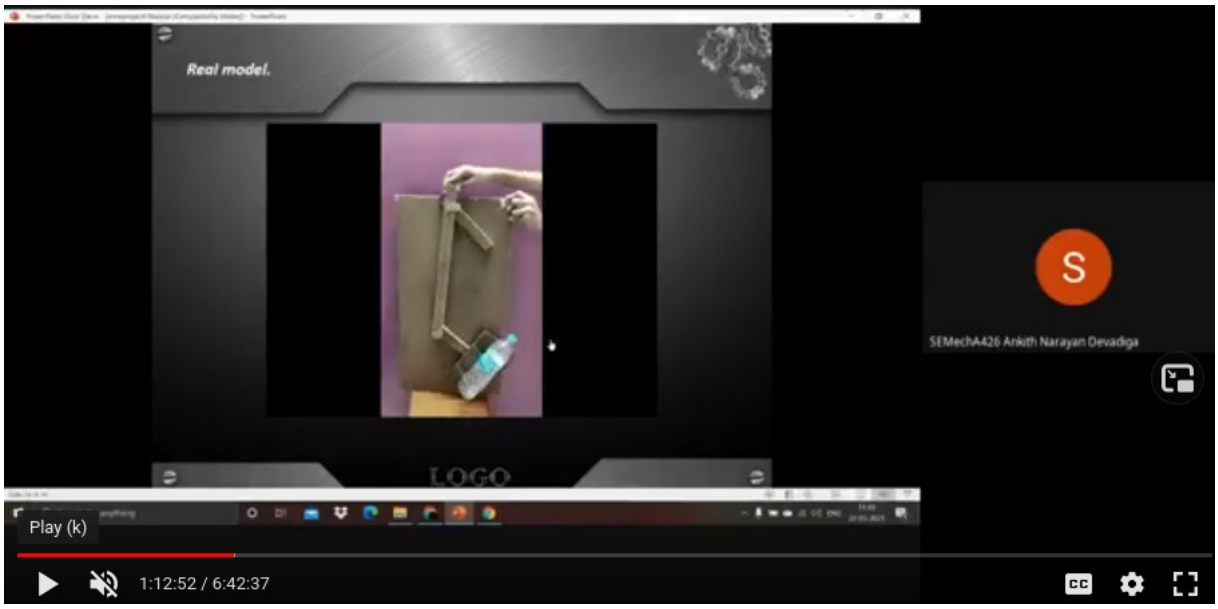
Right: A video snapshot of the prototype of liquid pouring mechanism demonstrating its use

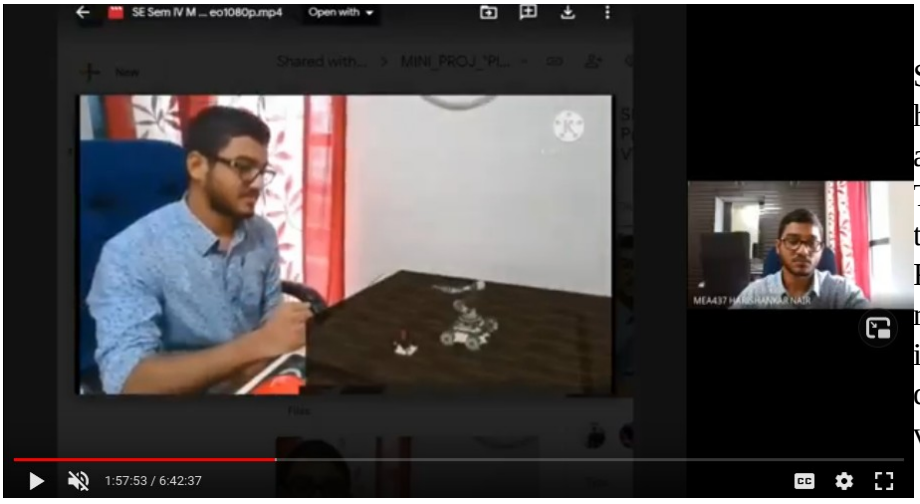
By Mayur Musale and Group, SE Mech-A

Few Snapshots from the Online Evaluations / Viva-voce:









Student demonstrating his group's work (Pick and Place Unit – Topic 3) virtually through Augmented Reality as seen in the recorded video, shown in these two snapshots during the online viva-voce session.