MECHANICAL TOY DESIGN PROJECT

SE Project Based Learning

Semester IV CBCGS (Rev. 2016)
Mechanical & Automobile Engineering
Pillai College of Engineering, New Panvel
2018-2019

Objective: To design and fabricate a mechanical toy that converts rotary motion to any other type of motion. This activity provides a platform for students to use their creativity and skills in designing animated mechanical toys. These mechanical toys can be brought to life by cranking (by using a battery to run a crank disc) to move a shaft mounted with a series of machine parts such as cams, gears, linkages, belts and pulleys, ratchets, etc. which are in turn connected to the various parts of the toy to produce the desired movement.

Outcomes: Students will learn

1. Use of CAD/CAM software for modelling and simulation of their design.
2. Basics of machines, transfer of power and energy selection of appropriate mechanisms
3. Basics of fabrication using CNC, laser cutting, 3D printing or any other fabrication technology.
4. Making a product safe to use for children and aesthetically pleasing.

Design Guidelines:

(i). Resources: Students should first visit various websites, such as the http://www.cabaret.co.uk/, http://automata.co.uk/ and http://www.flyingpig.co.uk/ websites before embarking on their own design. They should also visit various Design and Technology websites, such as the http://www.technologystudent.com/ (click "MECHANISMS" and "GEARS AND PULLEYS") to learn how mechanical toy parts can be animated by gears, timing belt and pulley drives, cams, linkage mechanisms, ratchet mechanisms, crank and crank shafts, etc.

(ii). Materials and Dimensions of Construction:

Students are required to build their toy sculpture using materials such as plywood, chipboard, softwood (balsa), wood, ball/cube/dowel, basswood sheet/strip, ice cream stick, plastic, high density foam, kapaline board (lightweight foam board), acrylic etc. They can also use 3D Printer and 2D Laser Cutting Machine from the Project Lab. to create their toy parts.

Students should use Ø10 mm wooden or steel rod as the main cranking shaft and driving shaft(s) of other critical toy parts so as to minimize shaft deflection and power transmission losses which will result in malfunctions of moving parts. The size of toy sculpture should not exceed 40 cm (Length) x 30 cm (Width) x 40 cm (Height).

The input crank shaft should be propelled in to motion by the use of a single 9 V battery. The input crank should be installed on the right-hand side and the direction of cranking should be indicated on the same side. Clockwise direction of cranking is preferred. Parts may be joined together by adhesive (glue), nails, screws or dowels. Pins may be used to create joints. Strings, wires, standard gears, belts and pulleys, etc., can be used to create the movements of the mechanical toy. Compression, extension and torsion springs of appropriate size and stiffness (about 0.5 mm wire diameter) should be connected to cam-followers, cranks and linkages, etc. to create the return or oscillating movements of moving toy parts.

Students should source for the above mentioned materials and standard parts before sizing their mechanical toy sculpture. These materials and standard parts can be purchased from school stationery/hobby shops.

Special care should be taken to ensure that the toy will be safe to use for small children (less than 10 years old). No sharp edges, hanging screws or nails! The design should also be asthetically pleasing with the outer covering of soft cloth, velvet, fur etc.

(iii). Additional Guidelines:

- Very simple motion transfer mechanism viz. rotation to rotation (e.g., that of a 4 bar crank mechanism of old railway engine wheels) should be avoided. There should be a combination of motion types, from input rotary motion to rectilinear motion, or input rotary (crank disc) to combined rotary and rectilinear motions of connecting parts.
- A mechanism of any level of complexity (4-bar chain, 6-bar, etc.) can be used by the student groups.
- Student groups should be able to calculate the motion characteristics of the final connected link/s of the mechanism (displacement, velocity and acceleration at important points) by hand calculations, and if possible, supplemented by software as simulated data for validation and verification.
- Care has to be taken that no part of the fabricated mechanical toy should be causing harm during its operation, since it is supposed to be used by a child for playing.
- A switch can be installed at a convenient location on the toy structure to start/stop the mechanism as and when required.
- The toy structure also needs to be very light, easily lifted by a child or a toddler.
- Additional emphasis shall be given to the mechanism which can produce as many multiple output motions from a single input rotary motion of the crank disc, also taking care that there should not be too many small parts, keeping in view the end user of the mechanical toy!
- Also, special emphasis shall be given to the mechanism which is unique and original, and where the idea (story) generated through motions/actions of the toy is also very creative, and maybe humorous!!!
- The mechanical toy also should be manufactured to be aesthetically pleasing to the eye.

Judging Criteria:

Design Description 10%
Poster Design (A3 size .ppt template) 10%
Functionality 20%
Model Quality 20%
Originality and Creativity 40%

Deadlines:

Students should submit their expected work through their class-coordinator, to the PBL Committee, in two stages as follows, for judging.

Stage 1(Tentatively on 1 March 2019, Friday)**:**

- Rough sketches (hand-made/computer assisted - 2D/3D) of possible mechanisms to obtain the desired motion/s of parts (at least 2-3 are expected).
- 3D modeling and Animation using any CAD software, of the selected best mechanism from the 2-3 design alternatives.
- A poster (on A3 size paper) using well defined template (consisting of PCE logo, and suitable headers and footers, apart from the main content of the toy mechanism).
- A report consisting of printouts of the rough sketches and the A3 sized poster shall be submitted to the judges during Stage-I evaluation, and soft copy of the model and animation shall be mailed to the PBL coordinator by this date.

Stage 2 (Tentatively on 5 April 2019, Friday):

- A well documented **report** consisting of detailed design description, andthe working model of the mechanical toy shall be submitted to the judges by this final evaluation date.

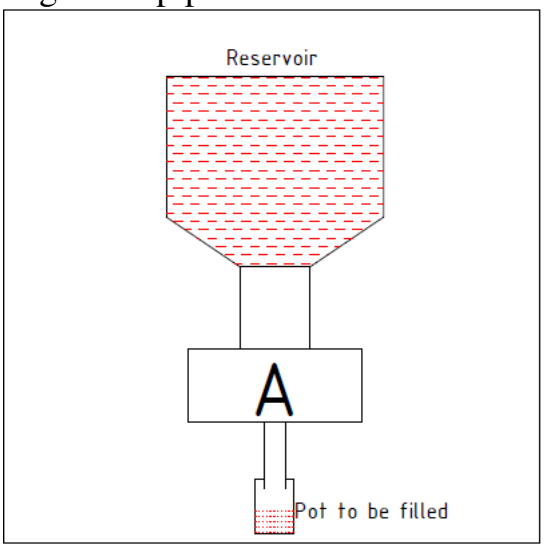
Courtesy: https://www.sp.edu.sg/engineering-cluster/mae/news/Toy-Design-Competition-2018

T.E. Mechanical/Automobile PBL (VI Sem) 2018-19

Problem Statement: - Design and develop device which allows 0.5 and 1 litre of water volume to be filled from given water reservoir. The device should supply accurate quantity with minimum overall cost and time.

Details:-

1. Design a device 'A' as shown in Figure. Device A will be connected to water reservoir which will be kept at some height.
2. Device 'A' may be mechanical or electrical with electronic interface.
3. Device 'A' must work automatically with minimum manual actuation.
4. Same device should have mode to switch from 0.5 litre to 1 litre.
5. Water reservoir and measuring instrument will be supplied at the time of evaluation.
6. Device should not pollute water.
7. Dimension of setup height and pipe diameter will be conveyed soon.



Evaluation Criteria:-

1. Accuracy of volume
2. Cost of device (Material, manufacturing)
3. Innovation
4. Time required for filling up desired water quantity.

Evaluation Dates planned :

1. Stage 1: 25th February (tentative)
2. Final evaluation/demonstration: First week of April