A REPORT ON

PROJECT BASED LEARNING (PBL)

for

Second Year and **Third** Year **Undergraduate Students** of **Mechanical and Automobile Engineering** Departments of **MES's Pillai College of Engineering, New Panvel**

for the **Academic Year 2016-2017 (Odd Semesters)**

Semesters - III & V (CBSGS)

Objective—To enable the students to apply concepts of the present semester subjects (including those of previous semesters) in the form of a design project based on certain application. It is hoped that it shall eventually lead to a better learning experience as opposed to text-book learning.

A common topic or two is assigned to all students of the same year, to provide a common yardstick for comparison and enable healthy competition among the different teams. The students work in groups (maximum 5-6 students per group) and assign and distribute various aspects of work so as to realize the project based on a timeline of about 2 months. Queries and doubts are clarified by interactions with the PBL coordinators and subject experts. Student groups submit the PBL report during their demonstrations on a specified date in front of the faculty members.

PBL Coordinator—M.Durga Rao

Judges for the PBL Demonstrations—All Mechanical and Automobile Engineering Faculty Members, including Teaching Assistants.

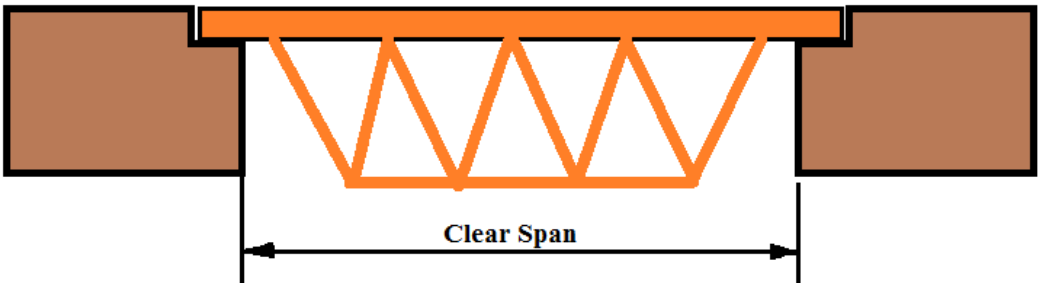
A **Group Chairman** is appointed by the members in each group—to facilitate communication between faculty members and other group members; also he/she is made responsible for submitting the project-work punctually.

Class: Second Year **Topic: <u>Bridge Engineering Project</u>**

Student Group: Maximum 5-6 members

The project is expected to meet the following **specifications**:

- Clear span of 1 m and free standing with the ends of the bridge relying on simple supports only (no horizontal reaction).
- Bridge deck must be continuous and at least 80 mm in width (to accommodate a loaded toy truck/vehicle).
- The tops of the deck and the bridge supports at either end must be flush to allow a smooth transition for the track.



- Any construction material or a mix of various materials can be used, but the total bridge mass must be limited to 300 grams. Typical materials include (but not limited to) wood of various types, plastic tube or sheet, cardboard, polystyrene or aluminium sheet etc. Joining methods of various types may be used.
- The bridge should be capable of carrying a worst case scenario load of 1.2 kg placed at its mid span without appreciable deformation.

Project Methodology:

- Understand the merits and demerits of different design options. The bridge is essentially a truss design concept so that a working model may be produced.
- Students are encouraged to think of alternative and potentially better ways of meeting the specifications.
- Perform Numerical Analysis (use of computers for simulation) to assess the load-deflection behavior of the proposed bridge. Look for STAAD-Pro frame-analysis software (freeware) for the same or similar software to perform the analysis.
- Analyze for deflections. Research engineering properties of materials and optimize their designs by shaping geometrical arrangement, material and/or sectional properties to limit the predicted deflection under worst case scenario condition of 1.2 kg at mid-span.
- Build the physical model. Conduct test/s in laboratory/class before their peers and colleagues. Measure mass of the bridge. Check the bridge against specifications for deflection at centre due to worst-case scenario load at mid-span, which may be measured by a dial gauge or suitable measuring instrument.
- The lightest model and the model with the least deflection shall be some of the deciding parameters to assess the group's performance over others.
- Each student in the group is expected to clearly state his/her degree of involvement in the project.
- Project Report—State reasons why the particular design concept is selected, with its novel features if any. Include the following in the report—engineering properties of construction materials used, the approach used in modeling the bridge, the input parameters and results of numerical analysis, manufacturing of the physical model, and comparison of predicted and actual mid-span deflections. Also include bill of material and cost analysis for obtaining the total cost incurred to create the physical model.
- Oral Presentation—not more than 10 minutes (5 minutes for Q&A session) for each group

Project Duration: 9 weeks (August – September 2016).

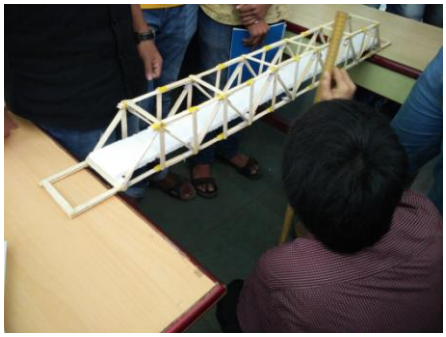
Oral Presentation: 1st week of October 2016 (end of course work, before submission of files).

Rubrics (for assessing group's performance)—presentation of concept design, numerical analysis, quality of physical model, performance rating of bridge, level of difficulty of design.

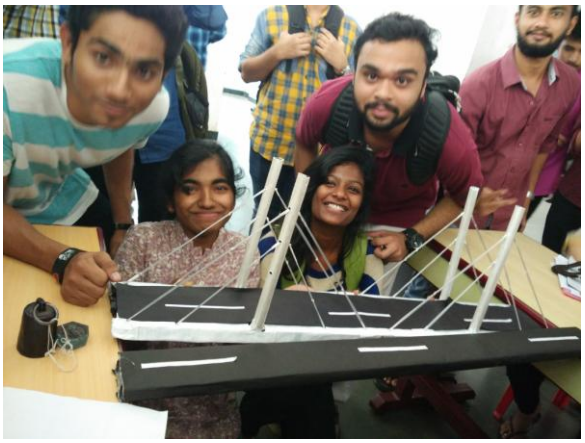
Relevance to Subjects: Strength of Materials, Mathematics, Production Processes, Computer Aided Drawing, Machine Shop Practice, Applied Mechanics, Computer Aided Analysis, Material Technology.

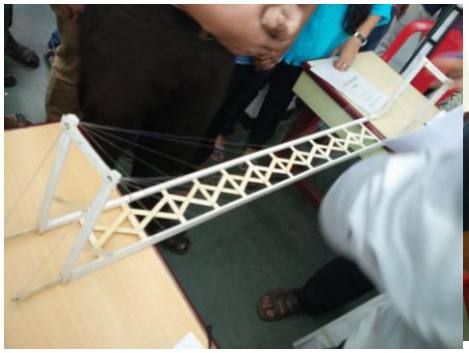
Courtesy: (Project idea adapted from) "Case study of a problem based bridge engineering course design—Brendan C. O'Kelly, International Symposium for Engineering Education, 2007, Dublin City University, Ireland.

Some photos taken during the Bridge Engineering Project Demonstration (on 13/10/2016):








Mahatma Education Society's
PILLAI COLLEGE OF ENGINEERING, New Panvel
Department of Mechanical and Automobile Engineering

PROJECT BASED LEARNING (PBL) DEMONSTRATION – RUBRICS & ASSESSMENT CHART

YEAR & CLASS: SE - MECHANICAL (A) **Date of Demonstration:** 13/10/2016

Title & Specifications of the Project: BRIDGE ENGINEERING PROJECT, Expected Total Weight of Bridge ≤ 300 grams, Weight to be lifted at mid-span of Simply Supported Beam = 1.2 kg, Clear Span between supports = 1 m, Minimum Width ≥ 80 mm, Expected Total Deflection at mid-span: The lesser-the better.

JUDGES: Prof._____ (Sign.) : Prof._____ (Sign.) : Prof._____ (Sign.) : Prof._____ (Sign.) : Prof._____ (Sign.) :

GROUP NO.	NAMES OF STUDENTS	ROLL NOS.	SIGN.	APPROX. COST OF PROJECT (Rs.) (exclude man-hours)	Materials Used for Constn. & Joining Methods etc.	RUBRICS & MARKS ALLOTTED: a. Presentation of Concept Design b. Whether work evenly distributed among members? c. Report (hard/ soft copy) submitted - Y/N? d. Level of Difficulty of design e. Numerical analysis using CAD/FEA software or CAD modelling done-Y/N (Optional) — 4 M	Measured Mid-span Deflection (mm) — 2 M	Measured Weight of Bridge (gms.) — 2 M	Build Quality of Model — 1 M	Measured Total Span (m) — 1 M	Measured Total Width (mm)	TOTAL MARKS for PBL — 10 M	THUMBLINE PHOTOGRAPHS of the Project Isometric, Plan, Front View & Side View
1						a. b. c. u. e.							Isometric Plan / Front / Side
2						a. b. c. d. e.							Isometric Plan / Front / Side
3						a. b. c. d. e.							Isometric Plan / Front / Side

Rubrics & Assessment Sheet for the topic BRIDGE ENGINEERING PROJECT (Second Year):

Class: Third Year **Topic 1: Mechanical Timer**

Student Group: Maximum 5-6 members

The project is expected to meet the following **Objectives**:

Design and build a **Mechanical Timer (no electronic components at all)** which shall perform an action at start (time 0) and then performs another action after the demanded time (by the judge) has been programmed into the machine/timer. This time can be anywhere between 30.0 seconds to 90.0 seconds. Use may be made of different concepts studied in mechanical engineering subjects so as to realize the timer.

Project Methodology:

- Students are encouraged to think of alternative and potentially better ways of meeting the specifications.
- For a selected mechanism, formulate in terms of the input parameters so that the timer functions between the set time limits. The formulation to estimate the time for functioning of the device based on a set of input parameters may be programmed using any programming software so as to simulate various conditions.
- Build the physical model and calibrate it. Conduct test/s in laboratory/class before peers and colleagues. Measure the time taken between two actions. Check the actual time measured with the time predicted based on the theoretical formula.
- The accuracy of time obtained over set value shall be one of the parameters to assess the group's performance over others.
- Each student in the group is expected to clearly state his/her degree of involvement in the project.
- Project Report—State reasons why the particular design concept is selected, with its novel features if any. Include the following in the report—engineering properties of construction materials used, the approach used in the theoretical modeling, the input parameters and results of the analysis, manufacturing of the physical model, and comparison of actual time spanned by the device with the initial time set before starting the test. Also include bill of material and cost analysis for obtaining the total cost incurred to create the physical model.
- Oral Presentation—not more than 10 minutes (5 minutes for Q&A session) for each group

Project Duration: 9 weeks (August – September 2016).

Oral Presentation: 1st week of October 2016 (end of course work, before submission of files).

Rubrics (for assessing group's performance)—presentation of concept design, theoretical analysis (formulation), quality of physical model, performance rating of device built, level of difficulty of design, cost and accuracy requirements.

Relevance to Subjects: Mathematics, Mechanical Measurements, Production Processes, Computer Programming, Machine Shop Practice, Concepts from Theory of Machines/Fluid Mechanics/Hydraulics Machinery/Heat Transfer etc. may be used depending on the working principle.

Courtesy: The project idea has been extracted from a question posted in a forum by Mr. Alex Lonescu, from the site: "alt.sci.physics.narkive.com/P2DDt5Ut/mechanical-clock-timer" of the Narkive Newsgroup Archive.

Some photos taken during the Mechanical Timer Project Demonstration (on 19/10/2016):

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PROJECT BASED LEARNING (PBL) DEMONSTRATION – RUBRICS & ASSESSMENT CHART
YEAR & CLASS: TE - MECHANICAL (A) **Date of Demonstration:** 19/10/2016

Title & Specifications of the Project: MECHANICAL TIMER. Design and build a **Mechanical Timer (no electronic components at all)** which shall perform an action at start (time 0) and then performs another action after the demanded time (by the judge) has been programmed into the machine/timer. This time can be anywhere between 30.0 seconds to 90.0 seconds. Use may be made of different concepts studied in mechanical engineering subjects so as to realize the timer.

JUDGES: Prof._____ (Sign.) : Prof._____ (Sign.) : Prof._____ (Sign.) : Prof._____ (Sign.) : Prof._____ (Sign.) :

GROUP NO.	NAMES OF STUDENTS	ROLL NOS.	SIGN.	APPROX. COST OF PROJECT (Rs.) (exclude man-hours)	Materials Used for Constn. & Joining Methods etc.	RUBRICS & MARKS ALLOTTED					TOTAL MARKS for PBL	THUMBLINE PHOTOGRAPHS of the Project Isometric, Plan, Front View & Side View
						a. Presentation of Concept Design b. Whether work evenly distributed among members? c. Report (hard/ soft copy) submitted - Y/N? d. Level of Difficulty of design	Numerical analysis using CAD/FEA software or Theoretical Modelling Whether done-Y/N	Comparison between Predicted (P) and Actual Measured (A) Timer Values (between 30-90 seconds, including the same)	Build Quality of Model	Novel Features and Other Remarks		
						4 M	2 M	2 M	1 M	1 M	10 M	
1						a. b. c. d.		P (s): A (s): Error (%):				Isometric / Plan / Front / Side
2						a. b. c. d.		P (s): A (s): Error (%):				Isometric / Plan / Front / Side
3						a. b. c. d.		P (s): A (s): Error (%):				Isometric / Plan / Front / Side

Rubrics & Assessment Sheet for the topic MECHANICAL TIMER (Third Year):

Class: Third Year **Topic 2: Windmill**

Student Group: Maximum 5-6 members

The project is expected to meet the following **Objectives**:

Design and build a Windmill which shall be used to lift a known weight (maximum 100 grams) through some fixed height (50 mm) in minimum time; when the input is a constant flow of air powered by a table fan. The air passes through the windmill in a horizontal direction.

Project Methodology:

- Students are encouraged to think of alternative and potentially better ways of design concepts meeting the specifications, in terms of types & number of blades and their construction material, the mechanism used to transfer the motion of the windmill shaft so as to create the lifting action of the weight etc.
- For a selected mechanism, formulate the optimum blade angles required, and the optimum number of blades for achieving the maximum economy.
- Design the blade thickness theoretically. Also, a finite element analysis software may be used to simulate the stresses built up in a blade during operation, and to check the safety considerations.
- Build the physical model. Conduct test/s in laboratory/class before peers and colleagues. Measure the time taken to lift the weight as per specifications. Compare the measured time with the theoretically estimated one to check accuracy of the model.
- Simulation studies may be undertaken to answer 'what-if' questions related to various values of input parameters.
- Each student in the group is expected to clearly state his/her degree of involvement in the project.
- Project Report—State reasons why the particular design concept is selected, with its novel features if any. Include the following in the report—engineering properties of construction materials used, the approach used in the theoretical modeling, the input parameters and results of the analysis, manufacturing of the physical model, and comparison of predicted and actual time taken to lift the weight. Also include bill of material and cost analysis for obtaining the total cost incurred to create the physical model.
- Oral Presentation—not more than 10 minutes (5 minutes for Q&A session) for each group

Project Duration: 9 weeks (August – September 2016).

Oral Presentation: 1st week of October 2016 (end of course work, before submission of files).

Rubrics (for assessing group's performance)—presentation of concept design, theoretical analysis (formulation), quality of physical model, performance rating of device built, level of difficulty of design, cost and accuracy requirements.

Relevance to Subjects: Mathematics, Mechanical Measurements, Production Processes, Fluid Mechanics, Machine Shop Practice, Concepts from Theory of Machines/Fluid Hydraulics Machinery, Material Technology.

Some photos taken during the Windmill Project Demonstration (on 19/10/2016):











Rubrics & Assessment Sheet for the topic WINDMILL (Third Year):

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PROJECT BASED LEARNING (PBL) DEMONSTRATION – RUBRICS & ASSESSMENT CHART

YEAR & CLASS: TE - MECHANICAL (A) **Date of Demonstration:** 19/10/2016

Title & Specifications of the Project: WINDMILL, Design and build a Windmill which shall be used to lift a known weight (maximum 100 grams) through some fixed height (50 mm) in minimum time; when the input is a constant flow of air powered by a table fan. The air passes through the windmill in a horizontal direction.

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GROUP NO.	NAMES OF STUDENTS	ROLL NOS.	SIGN.	APPROX. COST OF PROJECT (Rs.) (exclude man-hours)	Materials Used for Constn. & Joining Methods etc.	RUBRICS & MARKS ALLOTTED					TOTAL MARKS for PBL	THUMBLINE PHOTOGRAPHS of the Project Isometric, Plan, Front View & Side View
						a. Presentation of Concept Design b. Whether work evenly distributed among members? c. Report (hard/ soft copy) submitted - Y/N? d. Level of Difficulty of design	Numerical analysis using CAD/FEA software or Theoretical Modelling Whether done-Y/N	Comparison between Predicted (P) and Actual Measured (A) Times taken to lift the Weight by 50 mm	Build Quality of Model	Brake Power realised by the Windmill = (0.1 x 9.81) x 0.05 (N) (m) / A (s) Watts		
						4 M	2 M	1 M	1 M	2 M	10 M	
1						a. b. c. d.		P (s): A (s): Error (%):				Isometric / Plan / Front / Side
2						a. b. c. d.		P (s): A (s): Error (%):				Isometric / Plan / Front / Side
3						a. b. c. d.		P (s): A (s): Error (%):				Isometric / Plan / Front / Side