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Differential Equations: Calculus AB

Lesson Plan 5: Unit Project

Overview

This serves to set up the Unit-project. The students will work on it as groups, and present it at the end of the unit.

Learning Objectives

- What is the unit-project.
- Students will know their group, project subject, expectations from a complete project, and the time line.

Prior Knowledge needed

The students are already in the unit, so they will know 'some' of the project elements. Depending on when it is presented exactly during the unit, they might know more (or less).

Materials

Handout of unit-project.

Instruction and activity

1. **Unit project:**
    a. It's place in the unit as tying all subjects touched.
    b. Component of grade.
    c. Will be done in groups during a few lessons, and eventually presentation.
    d. We will be filling things in it as we learn them.
2. **Go over the handout.**
3. **Go over a sample project.**
    a. Show 'fact gathering' phase.
    b. Final result.
4. **Getting ready with groups**, and maybe start working on it (time permitting)**.**
5. **Homework (for weekend):** P. 412 : 85,87 Extra: 95

6. **Wrap-up :** A big project, with many parts, which we will work on during a few sessions. We'll monitor progress as we go.

====End====

Unit project – Differential equations

(information page to the student)

* Each group will be responsible to prepare and present a unit-project.

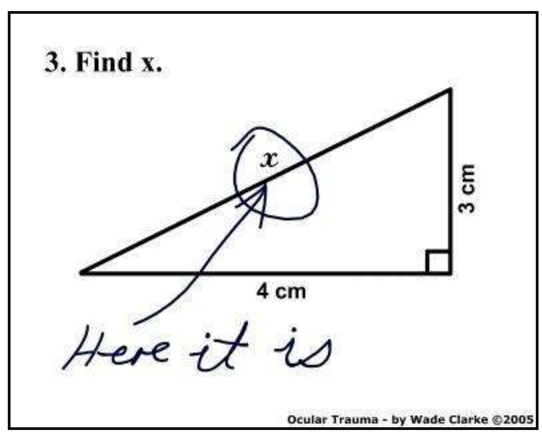
* Each group will be given a differential equation, with possibly some additional details about it, and will need to prepare presentation covering some (or all) of the following aspects:

1. **Equation origin** – Either as a physical model, or word explanation.
    a. **Derivation –** if possible.
2. **Applications**.
3. **History** – Some interesting historical fact(s) related to the equation.
4. **Analytic solution** – Please include solution verification.
5. **Solution curves**.
6. **Slope field**. (can be on the same plot as solution curves).
7. **Special cases** for the solution, and their physical/real-world interpretation.
    a. Initial conditions.
    b. Parameters.
    c. Behavior after a long time.
8. **Possible extensions** of this work.
9. **Other?!?** (be creative)
10. **Last but not the least:** Prepare two questions based on the presentation: One easy and one hard.

* We will start with fact-gathering stage, and toward the end will copy the information on transparencies for presentation.

➔ In the **final presentation**, each member presents at least one slide. The presentation should be between 5 to 10 minutes.

➔ You will need to submit (at time of presentation) a summary of **one-page per slide** that demonstrates the work behind the final representation of this slide. In other words, this is the elaboration/derivation of the slide.



* The audience will be given a form, on which they will need to:

a. Answer one question related to the presentation.

b. Supply a constructive feedback.

* If you are running out of ideas on some aspect, come and talk to me: Do not wait to the last minute!!

Have fun, and enjoy the learning experience!

Group 1: RC-Circuit with Voltage Source.

$$RC\frac{dV}{dt} + V = V_s \quad ; \quad V(t = 0) = 0$$

V(t) is the unknown function. R (resistor), C (Capacitor) , and V_s (Voltage source) are all known constants.

Group 2: RC-Circuit.

$$RC\frac{dV}{dt} + V = 0 \quad ; \quad V(t = 0) = V_0$$

V(t) is the unknown function. R (resistor), C (Capacitor) , and V_0 (Initial Voltage) are all known constants.

Group 3: RL-Circuit with Voltage Source.

$$L\frac{dI}{dt} + RI = V_s \quad ; \quad I(t = 0) = 0$$

I(t) is the unknown function. R (resistor), L (Inductor) , and V_s (Voltage source) are all known constants.

Group 4: RL-Circuit.

$$L\frac{dI}{dt} + RI = 0; \quad I(t = 0) = I_0$$

I(t) is the unknown function. R (resistor), L (Inductor) , and I_0 (Initial current) are all known constants.

Group 5: Non linear RC Circuit. (Desoer and Kuh, pp. 116-117) (H)

(where $I_R = V_R^3$, and assume C=1F)

$$C\frac{dV}{dt} + V^3 = 0 \quad ; \quad V(t = 0) = 0$$

Group 6: Mass Moving on a Plane with Friction.

$$M\frac{dv}{dt} = -Bv \quad ; \quad v(t = 0) = v_0$$

M – known mass ; B – Known friction coefficient ; $v(t)$ – unknown function to be determined.

Group 7: Population Growth Models. (H)

$$\frac{dN}{dt} = kN\left(N_{equi} - N\right) \quad ; \quad N(t = 0) = N_0$$

$N(t)$ is the population number, to be solved for. K, N_{equi} , and N_0 are known constants.

Group 8: Radioactive Decay.

$$\frac{dm}{dt} = -km \quad ; \quad m(t = 0) = m_0$$

$m(t)$ is the mass to be solved for. k and m_0 are known constants.

Solution examples.

$$RC * \frac{dV}{dt} + V \ = \ V_0$$