EE-306 Electromechanical Devices - Semester 162

Design Project

	First Name	Last Name	ID	Sr. #
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Speed Control of a DC Motor Using Ward-Leonard System

Objective

This term project primarily aims to make the students think out of the box and try to solve a given problem using their existing knowledge/experience and by exploring the relevant information from books (e.g., use of library) and web search. The students will build confidence in solving unknown but relevant problems in the field. The students will improve their teamwork skills.

Scope

The scope of the project is slightly above the level of usual class-work problems. Students will be equipped with design and technical skills to realize their abilities at the completion the of project.

Background

Speed control of DC motors is required in numerous applications such as in rolling mills, cranes, hoists, elevators, machine tools, and transit system and locomotive drives. DC motors are extensively used in many of these applications. Control of the speed of DC motors below and above the base (or rated) speed can easily be achieved. The technology of speed control of DC motors has evolved considerably over the past quarter-century. In the classical method, usually a Ward-Leonard system (Fig. 1) with rotating machines is used for speed control of DC motors.

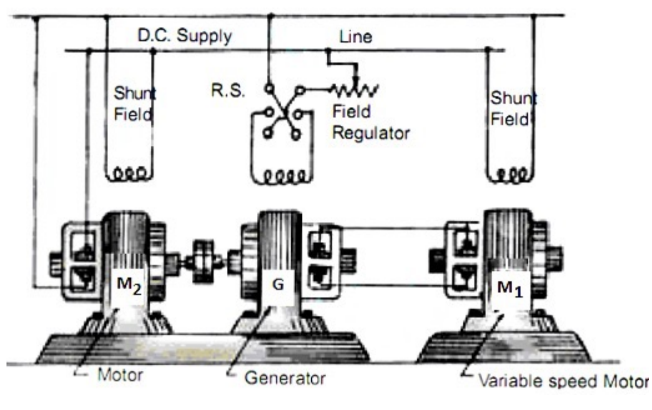

Figure 1: Ward-Leonard System of DC Motor Speed Control.

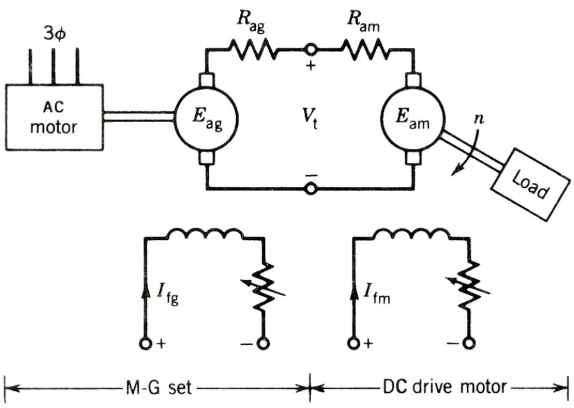

Figure 2: Ward-Leonard System - circuit diagram.

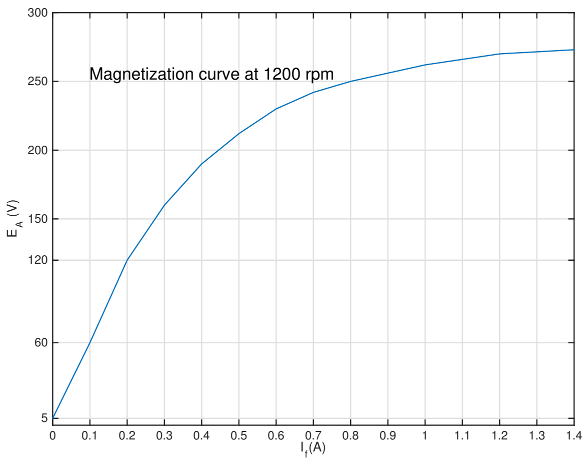

Figure 3: Magnetizaion curve of identical DC machines.

Consider a Ward Leonard method of speed control, as shown in Fig. 1, which is used for controlling the speed of a DC motor. It is a basic armature control method. This control system is consisting of a DC motor M_1 and powered by a DC generator G. In this method the speed of the DC motor (M_1) is controlled by applying variable voltage across its armature. This variable voltage is obtained using a motor-generator set which consists of a motor M_2 (either AC or DC motor) directly coupled with the generator G. It is a very widely used method of speed control of DC motor. Basic connection diagram of the Ward Leonard speed control system is shown in the Fig. 1. The corresponding electrical circuit diagram of Ward-Leonard System is shown in Fig. 2.

The speed of motor M_1 is to be controlled which is powered by the generator G. The shunt field of the motor M_1 is connected across the DC supply lines. Now, generator G is driven by the motor M_2. The speed of the motor M_2 is constant.

Design Specifications

The Ward-Leonard system shown in Fig. 1 uses two identical DC machines of rating 250 V, 5 kW, 1200 rpm. The armature resistance of each machine is 0.5 Ω. The generator is driven at a constant speed of 1200 rpm. The magnetization curve of each machine at 1200 rpm is given in Fig. 3.

Design Requirements

Scenario I - Motor Field Current Constant

If the motor field current I_{fm} is kept constant at 0.8 A

Determine the **maximum and minimum** values of the generator field current, I_{fg}, required for the motor to operate in a **speed range of 200 to 1200 rpm** at full-load armature current?

Scenario 2 - Generator Field Current Constant

The generator field current is kept at 1.0 A and the motor field current is reduced to 0.2 A.

Determine the speed of the motor at full-load armature current?

≼ ≼ End of project statement ≽ ≽
Good Luck!

see instructions on next page

Instructions to Candidates

- This is NOT an individual project. The students are encouraged to work in teams of two, where each team member would share equal grade
- You are required to submit a written project report
- Use formal title page of the report showing the names of team members and IDs
- The progress report should be computer generated one
- Handwritten report will not be accepted in any case
- The report should mention clear calculations, formulae used, and circuit diagrams with clear labeling
- The report must describe the assumptions made, if any
- Most importantly, a section "Discussions" should be added at the end of your report and a brief technical analysis of your calculations/project must be provided, e.g., you can give your recommendation to enhance the design
- You are encouraged to look into **Lecture Slides** first to find out the relevant concepts. Also, you can consult your course instructor if you have any confusion
- You can assume some appropriate data, if you feel it's missing. However, wrong assumptions will be penalized
- Finally, team members (group-mates) are highly encouraged to contribute equally within their own group but no team member/group is allowed to cross-communicate with other groups/members
- **Grading:** This project carries 5 absolute marks in total. The report carries 2 absolute marks, which will be based on clarity of calculations, clear writing and presentation in general. Late submission of the report will NOT be accepted
- **Report Submission:** The deadline for the submission of project report is:

Monday, 15 May 2017 (in class)