Engineering Tripos Part IIA Project, GB2: Electrical Power, 2017-18

Leader

Dr T Long [1]

Timing and Structure

Thursdays 11-1pm and Mondays 9-11am plus afternoons

Prerequisites

3B useful

Aims

The aims of the course are to:

- To introduce the techniques of conceptual design process.
- To introduce and develop methods for optimising designs through iteration of design equations.
- To gain an appreciation of the factors influencing power component designs.
- To have hands-on experience on developing and testing power electronic apparatus by prototyping AC/DC and DC/DC converters

Objectives

As specific objectives, by the end of the course students should be able to:

- Understanding the requirement specification and having an appreciation of technical challeges
- Identifying specific tasks for each group member and managing teamwork porgress
- Having practice on making power electronic circuits, including modelling, device selection, gate drive circuitry, coding and digital controller implementation, passive components design and making.
- Having practice on testing power electronic circuits, including instrumentation, sense for measurement

Content

This project will involve students in a wide variety of design issues within electrical engineering. Included are circuit design using integrated circuits, power semiconductor device circuits and the design of a transformer suitable for use with non-sinusoidal supplies.

A tight specification will be given for a prototype 24V dc to 230V ac (50Hz), 150W inverter for use as an emergency power supply in the event of mains failure. Simple calculations for the designs of each stage will be iterated such that a satisfactory solution is obtained. A complete inverter will be made by each group and thoroughly tested to establish whether it meets the specification.

Students will work in groups of four, comprising two pairs. Each student will write two interim reports and a shorter final report containing test results and conclusions.

Week 1

Conceptual design (Report 1).

Week 2

Design and build converter circuits for dc to dc and ac to dc conversion

Week 3

Test converter circuits and integrate (Report 2).

Week 4

Final assembly and test (Report 3).

MINI LECTURES

Three or four mini lectures will be presented covering:

- Introduction to circuit topologies
- Transformer design.
- Introduction to power semiconductor devices.
- Introduction to power semiconductor device gate drive circuitry

Circuits and methods

A detailed handbook and a collection of datasheets is given to each student. One practical design is outlined but there is no bar to using other designs if they are sensible. The datasheets are distributed simply to help with the conceptual design stage and no limit is placed on the availability of components. Following the conceptual design report, students may be encouraged or otherwise from following a particular path. Hence it may be expected that each group will produce a working inverter. Use of computers is encouraged, particularly for optimisation of the transformer design. Good quality general purpose electrical and electronic engineering facilities are available.

Coursework

Coursework	Due date	Marks
Interim report 1	Thursday 17 May 2018	20
Interim report 2	Thursday 24 May 2018	20
Final report	4pm Thursday 7 June 2018	30
	40% of the total marks for each of the three reports reflect group effort.	

Examination Guidelines

Please refer to Form & conduct of the examinations [2].

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[1] mailto:tl322@cam.ac.uk
[2] https://teaching19-20.eng.cam.ac.uk/content/form-conduct-examinations