1. Controller for an induction motor drive water pump based on a photovoltaic-powered system.

Suppose the use of induction motor pump capable of supplying a daily average 50 m^3 in range of 15- 30 m at head. The system will be installed on a place where the average solar radiation is 4 kWh/ m^3/day. The data of the main component specifications are: i) PV generator – Output voltage 300 V DC, Output power (peak) 2.8 kW, Motor-pump set – Input voltage – 15-230 Vrms, (three-phase, 50 Hz), Output power 1.1 kW.
Main goals:

- i) Analyse the main system requirements;
- ii) Design the power circuit structure and dimension the main components;
- iii) Design the control system and simulate its operation assuming ideal sinusoidal sources;
- iv) Repeat the simulations by replacing the ideal sources by a pulse-with-modulated inverter;
- v) Plan a set of tests to characterise the operation of the controller developed in transient and steady-state responses;
- vi) Redaction of final report.

2. Control system for an electric rail car

Develop an electric traction system based on an induction motor with gear reducer for driving a vehicle moving on rails for transporting products in a manufacturing process under widely varying conditions of friction.
The vehicle mass is 1000 kg, maximum load 2500 kg, desired speed range 0.5m/s to 3 m/s, wheel axle diameter 60 mm and wheel diameter 250 mm. The transmission mechanism between the gear reducer output and the wheel axle is a chain transmission with an efficiency of 0.9.
Main goals:

- i) Analyse the main system requirements;
- ii) Design the power circuit structure and dimension the main components;
- iii) Design the control system and simulate its operation assuming ideal sinusoidal sources;
- iv) Repeat the simulations by replacing the ideal sources by a pulse-with-modulated inverter:
- v) Plan a set of tests to characterise the operation of the controller developed in transient and steady-state responses;
- vi) Redaction of final report.

3. Control system for an index table

For this project pretends to develop a control system for an index table, using vector control method for permanent magnet synchronous motors (PMSM). The electric drive will be used for smooth indexing table movements. The index table have the following characteristics: Index time of 0,25 s, hold position 1, table in aluminum with a density of 2660 kg/m^3, outer diameter 500 mm and thickness 10 mm.
Main goals:

- i) Analyse the main system requirements;
- ii) Design the power circuit structure and dimension the main components;
- iii) Design the control system and simulate its operation assuming ideal sinusoidal sources;
- iv) Repeat the simulations by replacing the ideal sources by a pulse-with-modulated inverter;
- v) Plan a set of tests to characterise the operation of the controller developed in transient and steady-state responses;
- vi) Redaction of final report.

4. Position control of a load elevator

For this project pretends to develop a position control system, using direct torque control method for permanent magnet synchronous motors (PMSM) to be used in a load elevator.
The maximum load to be lifted is 2000 kg, with a speed of 1 m/s and an acceleration of 2 m/s^2. The transmission mechanism has an efficiency of 85% and the transmission ratio is 10.
Main goals:

i) Analyse the main system requirements;
ii) Design the power circuit structure and dimension the main components;
iii) Design the control system and simulate its operation assuming ideal sinusoidal sources;
iv) Repeat the simulations by replacing the ideal sources by a pulse-with-modulated inverter;
v) Plan a set of tests to characterise the operation of the controller developed in transient and steady-state responses;
vi) Redaction of final report.

5. Micro-hydro power generation system

This project will be conducted to develop a control system for a micro-hydro generation system using a permanent magnet synchronous generator as an off grid three-phase power generator of 400V, 50 Hz. One diode bridge rectifier is used to build a DC bus at conversion energy chain.
The average hydraulic power available at the turbine is 4kW and the turbine efficiency is 75%.
Main goals:

i) Analyse the main system requirements;
ii) Design the power circuit structure and dimension the main components;
iii) Design the control system and simulate its operation at constant speed.
iv) Implemented architecture and its control design for variable speed operation;
v) Plan a set of tests to characterise the operation of the controller developed in transient and steady-state responses;
vi) Redaction of final report.

6. Develop a water pump system based on Brushless DC motor fed by a photovoltaic module.

Suppose the use of trapezoidal permanent magnet synchronous motor (Brushless DC Motor) capable of supplying a daily average 30 m^3 in range of 10- 20 m at head. The system will be installed on a place where the average solar radiation is 4 kWh/ m^3/day. The data of the main component specifications are: i) PV generator – Output voltage 300 V DC, Output power (peak) 2.8 kW, Motor-pump set – Three-phase, rated Power – 1kW, 500 V_{DC}, 3000 rpm.
Main goals:

i) Analyse the main system requirements;
ii) Design the power circuit structure and dimension the main components;
iii) Design the control system and simulate its operation assuming ideal sinusoidal sources;
iv) Repeat the simulations by replacing the ideal sources by a pulse-with-modulated inverter;
v) Plan a set of tests to characterise the operation of the controller developed in transient and steady-state responses;
vi) Redaction of final report.

7. Monorail crane motion control system

For this project pretends to develop a control system for controlling a crane trolley using an induction motor. In addition to accurate positioning of the load, the controller must provide low load oscillation for minimum load travel time.
The maximum load to be lifted is 250 kg, the lifting height 3-5m, with a speed of 6-10 m/min and the maximum vertical central deflections must be lower than 100 mm. The mass of the trolley and hook are 30 kg.
Main goals:

vii) Analyse the main system requirements;
viii) Design the power circuit structure and dimension the main components;
ix) Design the control system and simulate its operation assuming ideal sinusoidal sources;
x) Repeat the simulations by replacing the ideal sources by a pulse-with-modulated inverter;
xi) Plan a set of tests to characterise the operation of the controller developed in transient and steady-state responses;

xii) Redaction of final report.

8. Control technique for a three-phase grid-tie inverter

Develop a controller for a three-phase voltage-source inverter which is connected at an ideal AC power grid 230/400 Vrms, 50 Hz. Suppose that the inverter receives energy from a controllable DC current source with rated power is 3kW and its rated voltage is 600V.
Main goals:

i) Analyse the main system requirements;
ii) Design the power circuit structure and dimension the main components;
iii) Design the control system and simulate its operation at constant power.
iv) Implemented architecture and its control design for variable DC power operation.
v) Plan a set of tests to characterise the operation of the controller developed in transient and steady-state responses;
vi) Redaction of final report.

9. Power splitting control methodologies for a fuel cell electric vehicle

The fuel cells in conjunction with supercapacitors can create high power energy system with fast dynamic response which makes it well suitable for electric vehicles in future. In this project the fuel cells with supercapacitors coupled in parallel with the fuel cell through a DC/DC converter is considered. This technical solution can maximize the utilization of supercapacitors during acceleration, regenerative braking and mitigate the stress on the fuel cell stack.
Main goals:

i) Analyse the main system requirements;
ii) Design the power circuit structure and dimension the main components;
iii) Design the power split control and simulate its operation for different constant speed of vehicle.
iv) Implemented architecture and its control design and simulate for different driving-cycles;
v) Plan a set of tests to characterise the operation of the controller developed in transient and steady-state responses;
vi) Redaction of final report.