EAE ENGINEERING CHALLENGE INSTRUCTIONS

Thank you for your interest in joining our team. Below you will find two challenges:

1. **EAE CAD Modelling Challenge**
    - Complete this challenge if you are applying for a mechanical or mechatronics position
2. **EAE Electrical and Controls Challenge**
    - Complete this challenge if you are applying for a mechatronic, electrical or firmware position

Please complete the challenge that is relevant to the position you are applying to. However, we strongly encourage curiosity and versatility. For bonus points, feel free to tackle parts of other challenges even if the content falls outside of your main discipline.

When you complete your challenge submission, please zip relevant files and name the folder "Firstname_Lastname".

Upload zip file to https://www.dropbox.com/request/lWsqgmlippMljbL76SVi

Please refer to Sections 4 and for submission format, any incomplete submissions will not be evaluated.

EAE CAD MODELLING CHALLENGE

Complete this challenge if you are applying for a mechanical or mechatronics position.

1 Steel Fabrication and System Design

You have been provided with a top-level assembly called "front of chassis". Your task is to mount a motor (FVT0001006) and a traction inverter (FVT0000363) within this assembly. It is important that we understand your assumptions and reasoning for this part of the challenge, so please provide documentation to that effect.

1.1 Motor Mount

Open the part file "FVT001006", this is an electric motor (Cascadia Motion HVH410-150). Create a mounting system that will support the motor with mounting points in the specified locations marked as "+" symbols in Figure 1. Your design constraints and considerations are:

- Use standard inch-sizes of mild steel, and keep it ½ inch or less in thickness
- Mounts and brackets can only be built using a CNC plasma table, welder and press brake
- Your system should contain (and later, utilise) 4 mounting holes in the locations seen in *Figure 1*
- Consider all connections to and from the motor along with its orientation/clocking
- Specify bolt holes, threads and whatever else may be important
- Popsicle sticks and blue bubblegum are also available

Your deliverables for this section are:

A. Create a new assembly that contains the motor and your motor mount and label it “EAE_MOUNT”, export as a STEP file

1.2 Top Level Assembly

Place the inverter and your “EAE_MOUNT” assembly within the top-level assembly and connect the motor to the transmission however you see fit.

- Creating more mounting systems is allowed
- Welding onto, and/or drilling into the frame is acceptable if you don’t think it will negatively affect the structure

Your deliverables for this section are:

A. Create a new top level assembly named “EAE_TL” and export as a STEP file

1.3 Justification

Finally, create a report, presentation or other document justifying your decisions and explaining any relevant assumptions used in Section 1.

Your deliverables for this section are:

A. A PDF report, presentation or document named “EAE_CAD_Justification”

2 Drawing

In the “Remy-Yoke Shaft Full Assembly” open the part titled “Motor Mounting Plate_2”. Create an engineering drawing of this part.

Your deliverables for this section are:

A. A PDF drawing named “Motor Mounting Plate_2”

3 Part Design (Optional)

Find attached a drawing of a universal joint (*Figure 2*). Model the drawing in 3D as best you can with the given information, focusing on the features most important for the parts application.

Your deliverables for this section are:

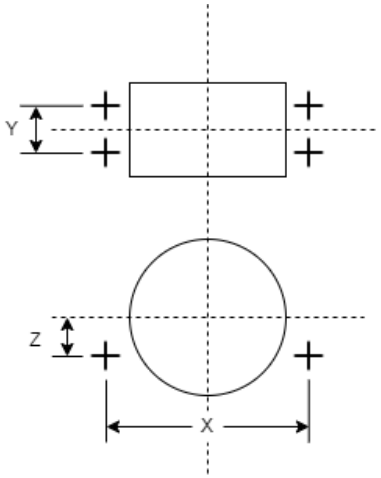
A. Create a part file named “EAE_part3” and export as a STEP file

4 Submission

Your final submission to the Dropbox for the EAE CAD Modelling Challenge should consist of:

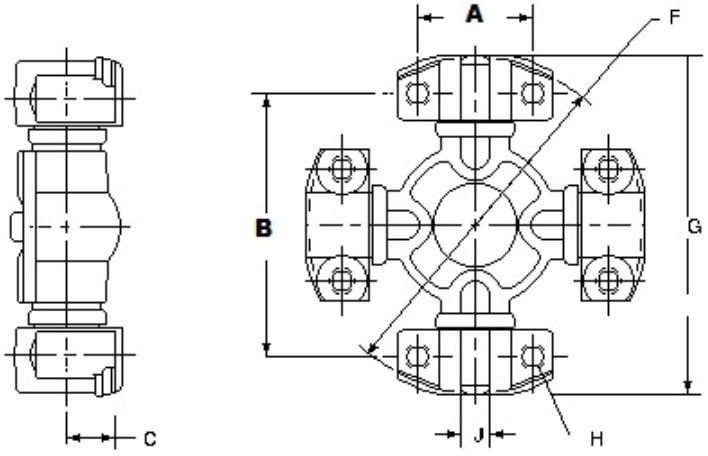
1. **EAE_MOUNT step file**
2. **EAE_TL step file**
3. **EAE_CAD_Justification PDF**
4. **Motor Mounting Plate_2 PDF**
5. **EAE_part3 step file** (if complete)

Figure 1.



X = 635 mm
Y = 100mm
Z = 100 mm

Figure 2.



A	B	C	F	G	H	J
1.94	4.62	0.81	5.84	6.22	0.437-20	0.625

.50"-20 bolts * torque to 80 ft/lbs *

EAE ELECTRICAL AND CONTROLS CHALLENGE

5 Cooling Schematic

The schematic in Figure 3 shows a cooling loop for an inverter and DC-DC. It has the following components,

1. Brushless Water Pump
2. Filter
3. Radiator with Fan
4. Temperature Sensor
5. Inverter
6. DC-DC Converter
7. Open Reservoir
8. Level Switch
9. Orifice

Identify the errors in this schematic and create a brief report or presentation to explain any benefits and drawbacks of the changes you made to the system.

Your deliverables for this section are:

A. A PDF report, presentation or document named “EAE_Cooling_Justification”

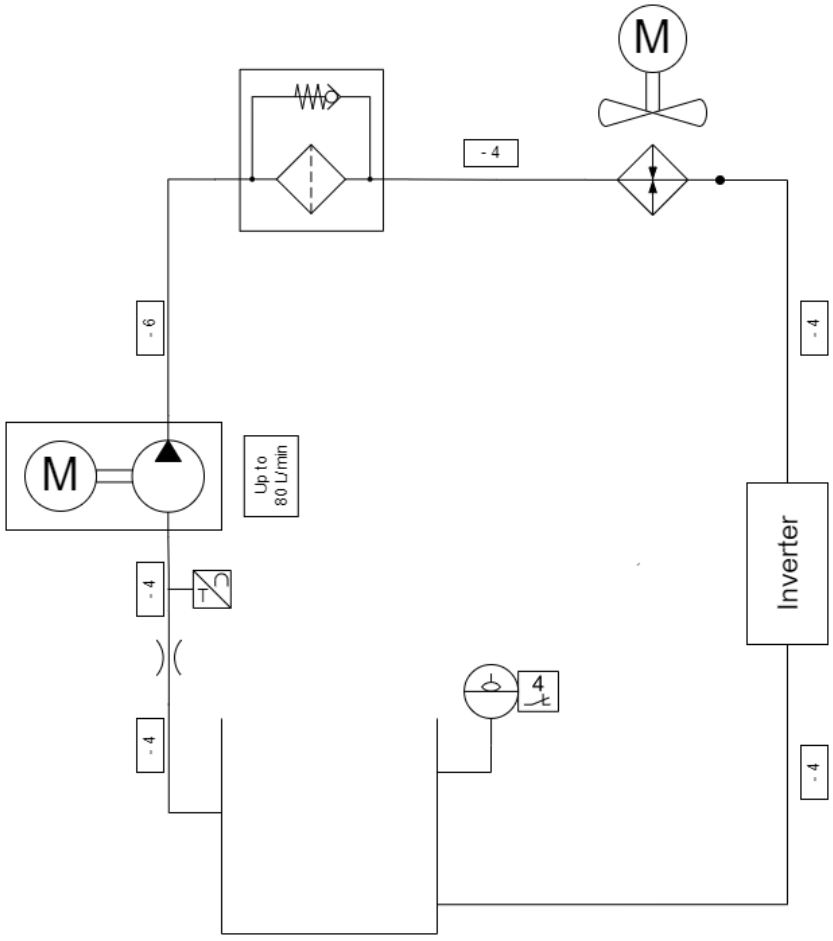


Figure 3 - Original Cooling Schematic

6 Electrical Schematic

Draw the electrical circuit diagram for the components used in the Section 5. Datasheets for the components have been included. You do not need to wire anything to the inverter in Figure 3.

This is a mobile application. There is no right answer as there are multiple ways the system can be configured.

The list of components you should use is below. You can also use diodes, relays, and fuse or circuit breakers where appropriate.

1. Two 12V lead acid batteries
2. F-Series Single Pole Toggle Switch – For system Ignition
3. IFM PLC CR0403
4. EMP Pump WP32
5. Power View Screen – Used to view temperature and pump status
6. H-WTMS Temperature Sensor
7. VA97-BBL339P/N-103A Fan
8. LMC100 Liquid Level Switch

Create the electrical schematic with the program of your choice. Straight-edge hand-drawn is also acceptable.

Your deliverables for this section are:

A. A PDF schematic named “EAE_Electrical_Schematic”

7 Coding

Write the logic for the cooling loop in Section 5 that would run on the PLC to control the coolant temperature so that the Inverter and DC-DC can operate at max power without derating. You should consider the following.

1. Temperature Sensor Input
2. Ignition Switch Input
3. Controlling the Pump
4. Controlling the Fan
5. Applicable Safety Functions

Instructions:

- Write meaningful code comments
- Use proper indentation
- Use variables with emulated data to demonstrate your program.

You may use any ONE of the methods below to demonstrate your skills:

1. Pseudo code. (Use a text editor)
2. PLC emulator available from Software Downloads (automationdirect.com).
3. C/C++ Code using a GCC compiler and MSYS2 shell. Use fake variable values to demonstrate working logic. (Your code must compile and run). Use the links provided to set up a dev environment (MSYS2) C++ programming with Visual Studio Code.
4. Python Welcome to Python.org Python in Visual Studio Code.

Your deliverables for this section are:

A. Zip your program folder on completion and name it “EAE_Coding”

7.1 Firmware

This section is optional for mechatronic and electrical candidates.

1. Simulate sending and receiving data over CANBUS.
2. Use a PID loop.
3. Create a state machine.
4. Pass command line arguments for setpoints.
5. Use external dependencies managed by CMake or Vcpkg.
6. Build on Linux, use a shell script to launch and pass params at runtime or use MSYS2 and python.
7. Use Gtest to implement unit testing.
8. “DO NOT” ship dependencies in your project, use static linking or use your build system.

Your deliverables for this section are:

A. Create a GitHub repository for your submission and name it “EAE_Firmware”

8 Submission

Your final submission to the Dropbox for the EAE Electrical and Controls should consist of:

1. **EAE_Cooling_Justification PDF**
2. **EAE_Electrical_Schematic PDF**
3. **EAE_Coding zip file**
4. **EAE_Firmware GitHub repository location**