EML2322L – MAE Design and Manufacturing Laboratory

Detailed Design (DR3) Checklist

Group Number: _____ **TA** or **Group Performing Evaluation: _____**

Grade: _____ **Original Submission** or **Resubmission** (circle one)

DESIGN CHECKLIST. Are the following items COMPLETE?

- ☐ YES ☐ NO Accurate assembly model for the mobile platform, including frame, attachment brackets, motors and mounts, wheel hubs, wheels, control box, and associated fasteners?
- ☐ YES ☐ NO Detail drawing(s) of motor mounts? Is material choice, geometry, attachment method, and general design justified?
- ☐ YES ☐ NO Detail drawing(s) of wheel hubs? Is material choice, thickness, geometry, torque transmission method, and general design justified?
- ☐ YES ☐ NO One simplified detail drawing for all unmodified pieces of 80/20 that includes a table with lengths, tols. and part numbers? Additional drawings for modified pieces.
- ☐ YES ☐ NO Assembly models and detail drawings for all other mechanisms and components?
- ☐ YES ☐ NO Detail drawings of all OTS components used on the project with clear dimensions of all features used to interface with other components (bolt patterns, shaft details, etc.)?

ASSEMBLY DRAWINGS / BOM. Do the assembly drawings and BOM include the following?

- ☐ YES ☐ NO Complete BOM of entire design (i.e. one consolidated BOM table for quick reference)?
- ☐ YES ☐ NO Required assembly drawing template provided on the course webpage?
- ☐ YES ☐ NO ALL parts of the robot, including OTS components, fasteners, string, tape, etc.?
- ☐ YES ☐ NO Multiple views clearly showing all components of the design?
- ☐ YES ☐ NO Is each part's attachment method clearly defined?
- ☐ YES ☐ NO Required subassemblies of the frame, drivetrain, manipulator(s), hopper, sorter, etc.?
- ☐ YES ☐ NO Clear exploded views of all subassemblies
- ☐ YES ☐ NO Unique, sequentially labeled balloons pointing to every piece of the assembly?
- ☐ YES ☐ NO Assemblies denoted by *EML2322L-A-XXX* in their drawing numbers?
- ☐ YES ☐ NO Dimensions showing how individual pieces are located with respect to each other? (Individual feature dimensions should remain on detail drawings where they belong.)
- ☐ YES ☐ NO Proper fasteners for each component? (i.e. 1/4-20 for 80/20, 10-24 for wheel hubs, M6x1.0 & M8x1.25 for Entstort motors, M4x0.7 for Denso motors and 10-32 for Molon motors)
- ☐ YES ☐ NO Proper fastener descriptions on BOM including thread specification, length and head type? (i.e. *"¼-20 x ½" button head cap screw"* or *"M6x1.0 x 25mm hex head bolt"*)

WRITTEN DESCRIPTION, SCHEDULE, BUDGET & REMAINING CALCULATIONS.

- ☐ YES ☐ NO Does the written design description clearly explain the final design?
- ☐ YES ☐ NO Does the group use the required schedule template and is it clearly formatted?
- ☐ YES ☐ NO Does the schedule contain detailed individual tasks and reasonable deadlines based on the time estimation guidelines provided for part manufacturing?
- ☐ YES ☐ NO Does the schedule assign individual tasks to individual members?
- ☐ YES ☐ NO Does the schedule include the welding demo, any holidays, and adequate testing time?
- ☐ YES ☐ NO Does the group use the required budget template and is it clearly formatted?
- ☐ YES ☐ NO Does the budget include ALL raw materials needed for prototype manufacturing?
- ☐ YES ☐ NO Does the group properly compute prices for materials in the budget?
- ☐ YES ☐ NO Does the total project budget meet the cost limit?
- ☐ YES ☐ NO Are calculations reported with a reasonable and consistent number of decimal places?

DRAWINGS & DIMENSIONING. Highlights from the Dimensioning Rules document.

1. Never shade isometric or orthographic engineering drawings.
2. Always show hidden lines in orthographic views.
3. Always show tangent lines in isometric views, but never show hidden lines or dimensions.
4. Do not place too many views on one page or scale the views too small (spread across multiple sheets); likewise, do not place too many dimensions on one view if doing so affects drawing presentation.
5. Each dimension should be given clearly so it can be interpreted in only one way.
6. Do not place dimensions on a view unless clarity is promoted and long extension lines are avoided.
7. Dimensions should be placed in the views where the features dimensioned are shown true shape.
8. Dimensioning to hidden lines should always be avoided; use cross sectional views instead.
9. Dimensions should be so given that it will not be necessary for the machinist to calculate, scale, or assume any dimension.
10. Finish marks should be placed on the edge views of all finished surfaces.
11. Drill sizes should be expressed in decimals (i.e. Ø 0.257, Ø 0.266, etc.) with an assigned tolerance.
12. Circles (holes) are always dimensioned by the DIAMETER and arcs (fillets) by the RADIUS.
13. A diameter dimension should always be preceded by the symbol Ø, and a radius dim. by the letter R.
14. When there are several rough, non-critical features obviously the same size (fillets, rounds, ribs, etc.), it is permissible to give only typical (abbreviation TYP) dimensions or to use a note.
15. Decimal dimensions should be used for all machining dimensions. Decimal dimensions less than 1.0 should be preceded with a leading zero (i.e. 0.375).

DETAIL DRAWINGS. Does each drawing have the following information?

☐ YES ☐ NO Appropriate EML2322L drawing template and title block
☐ YES ☐ NO Dimensions to properly locate EVERY part feature
☐ YES ☐ NO Appropriate tolerances for EVERY dimension
☐ YES ☐ NO Proper surface finish notes for EVERY surface (rarely *"finish all surfaces"*)
☐ YES ☐ NO Proper hole and thread notes based on the tap chart
☐ YES ☐ NO Part designer's name
☐ YES ☐ NO Part drawer's name
☐ YES ☐ NO Drawing units
☐ YES ☐ NO Material type
☐ YES ☐ NO Quantity of parts to be manufactured
☐ YES ☐ NO Unique part name / number
☐ YES ☐ NO Deburring instructions

☐ YES ☐ NO Are the highlighted rules in the Drawings & Dimensioning section followed?
☐ YES ☐ NO Are drawings full page and of nice print quality? (Print… to pdf, not directly to a printer)
☐ YES ☐ NO Are dimensions well organized and do they use consistent fonts and line weights?
☐ YES ☐ NO Do tolerance tables fit individual part requirements? (Modify for each as necessary.)

FASTENERS, THREADS, AND HOLES.

☐ YES ☐ NO Are threaded holes designed with AT LEAST FIVE threads of engagement?
☐ YES ☐ NO Are the proper type of threads (coarse or fine) used in the proper type of material?
☐ YES ☐ NO Are tap drill sizes correct based on the tap chart standards?
☐ YES ☐ NO Are clearance holes properly sized using close and free fit standards off the tap chart?
☐ YES ☐ NO Are fasteners selected which are routinely stocked in the lab? (Other fasteners can be ordered by submitting a purchase order form, but doing so creates more work for your team.)
☐ YES ☐ NO Do fastener head types allow for adequate motion with required assembly tools? (i.e. screwdrivers, allen wrenches, sockets & ratchets, rivet guns, etc.)?
☐ YES ☐ NO Do motor mounting brackets use all of the provided motor mounting holes? (The Globe motor is the only exception)

SHEETMETAL PARTS.

□ YES □ NO Is part modeled using SolidWorks sheetmetal tools?
□ YES □ NO Do sheetmetal part drawings include folded AND unfolded part views?
□ YES □ NO Is material proper thickness for the application? (Too thick is hard to bend; too thin is flimsy.)
□ YES □ NO Is part designed for manufacturing according to the Sheetmetal Design Guide? (Complex parts split into multiple simpler parts, integrated weld tabs, etc.)
□ YES □ NO If the part is to be welded, is it specified as steel? (Aluminum is much harder to weld.)

DESIGN FOR MANUFACTURING (DFM).

□ YES □ NO Is each part as small as possible without affecting its function?
□ YES □ NO Is each feature tolerance as large as possible while still meeting desired design intent? (Mfg. time increases exponentially with feature tolerance.)
□ YES □ NO Is each finished surface necessary for part function? Are the coarsest surface finish specifications used wherever possible? (Mfg. time increases exponentially with surface finish.)
□ YES □ NO Is the number of dimension datums minimized? (Less edge findings = quicker part production.)
□ YES □ NO Are material choices justified? Are lower strength materials that are easier to machine used everywhere possible? (Steel for example requires 3 times as long to machine as aluminum.)
□ YES □ NO When possible are thru bolted holes used instead of threaded holes to reduce mfg. time?
□ YES □ NO Are nominal (vs. arbitrary) part dimensions used where possible? (i.e. 3.00″ vs. 3.04″)
□ YES □ NO Are parts designed for minimum raw-stock removal? (Less material removed = cheaper part.)
□ YES □ NO Are similar parts designed to be identical instead of mirror images? (i.e. motor mounts)
□ YES □ NO Is each part feature designed around nominal (commonly produced) cutter sizes?
□ YES □ NO Have unnecessary features that increase manufacturing time been eliminated? (fillets, etc.)

□ YES □ NO Is the assembly model accurate and has it been used to check for part interferences while still in the design phase? (The assembly model is not an academic exercise and these types of problems are MUCH more difficult to fix in the prototyping phase of the project.)
□ YES □ NO Does the design allow space for assembly tools? (i.e. screwdrivers, sockets, wrenches)
□ YES □ NO Have alternative designs been investigated which may lower manufacturing and assembly times? (i.e. designs which combine parts, or split parts; or designs which use sheetmetal vs. billet)?

APPENDICES.

□ YES □ NO Is Appendix D (Est. Budget) properly labeled and located using the required template formatting and instructions in the DRT?

GENERAL POINTS.

□ YES □ NO Does the final design meet all design objectives? (i.e. size, storage in box, team number, etc.)
□ YES □ NO Is the design feasible and realizable with the resource provided? (Ask questions before submitting a design you aren't sure can be made within the allotted time frame)
□ YES □ NO Does your team number appear on both sides of the robot using at least 3" tall characters?

□ YES □ NO Are grammar, spelling, formatting, and printing at a collegiate level? (Mistakes will be graded harshly. If you don't take pride in your work, no one else will either.)
□ YES □ NO Did you read and avoid the errors noted in the common mistakes section of the DRT?

□ YES □ NO Is the report submitted in a properly sized and organized binder according to the DRT?
□ YES □ NO Does the report notebook contain page lifters to prevent pages from tearing out when opening the notebook? (If they can't be found in the store, ask for a pair in the lab.)
□ YES □ NO Are computer-generated, glued-in page tabs used to organize the report in the order shown in the DRT?