

University of Wales Trinity Saint David

Institute of Science & Art



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Group Project

Integrating project (ACHA4008)

Michael Charity

2100477

April 2022

Contents

1	Introduction	1
2	Design.....	2
2.1	Chassis.....	2
2.2	Stub axle assembly.....	2
2.3	Wishbone	3
3	Analysis	4

1 Introduction

The final design is similar to the initial concept proposed in part one.

The changes made were mostly in regards suspension geometry in order to minimize the change in camber through the normal travel of out wishbones.

Stress analysis has also been carried out to gain insight on how these parts may behave under extreme and typical operating conditions.

2 Design

2.1 Chassis

As shown below in fig. 1 the final chassis design is an aluminum tubular chassis, made from 6063 aluminum in either 31.75mm or 25.4mm aluminum tubing depending on location, for example some of the less areas of the chassis would accept 25.4mm tubing however it was thought better to use 31.75mm for areas such as the crash hoop and at points where the suspension system met the chassis. The weldment/structural member feature was primarily used to create the chassis. Suspension is the same independent suspension however with the upper wishbone mounts reduced brough out from the center line by 90mm front and rear.

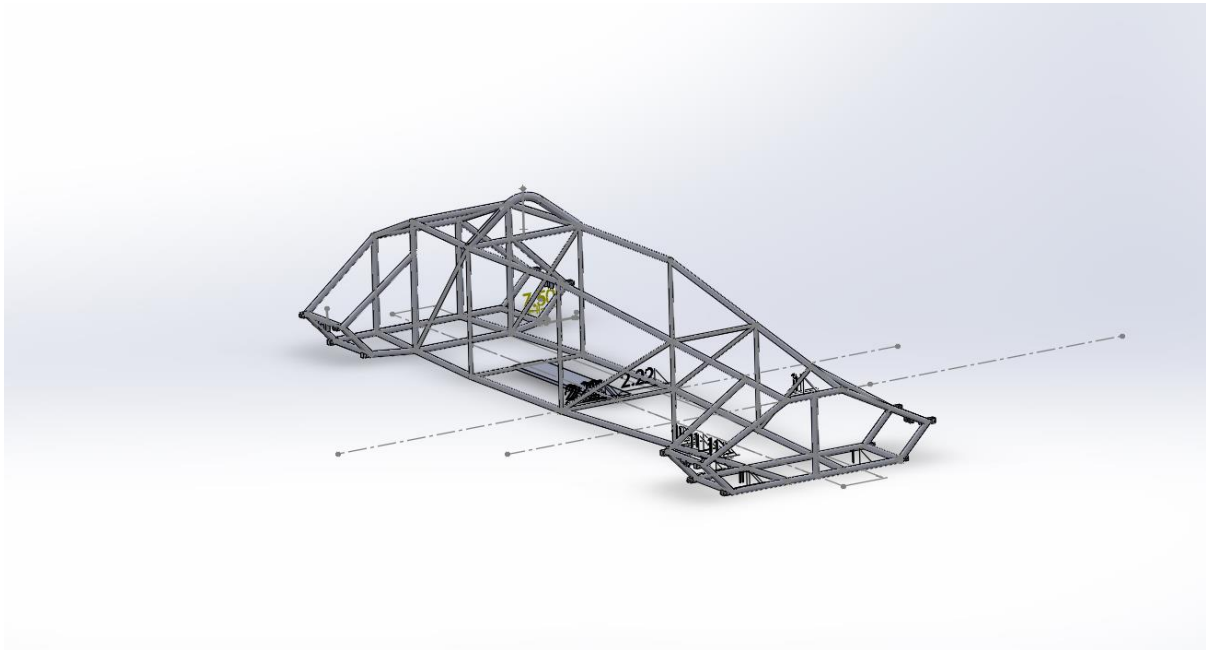


Fig.1

2.2 Stub axle assembly

The stub axle and hub, Fig 2-3, features two ball joints in order to mount on the wishbone, a mount for the tie rods and can be fitted with a 55x35x10mm angular contact bearing, typically these have a rating of 7kN dynamic load and able to withstand reasonable axial and radial loads with the shoulder facing back to back. The spacer between the two bearings therefore must be accurately produced in order to ensure the preload is correct. Using deep groove roller bearings may have been an improvement due to the relative ease of production they provide.

Another improvement would have been to design the part with an off the shelf ball joint.

Modification the wishbone would have also been in order for this to be facilitated.

this change.

The caliper mountings are not specific to any caliper, the idea being to use adapter plates in order to accommodate different size brake discs.

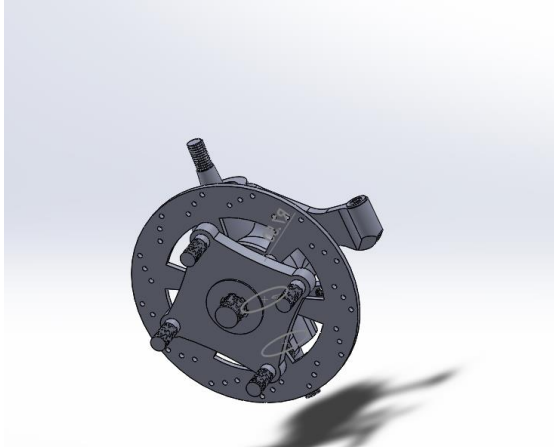


Fig 2.

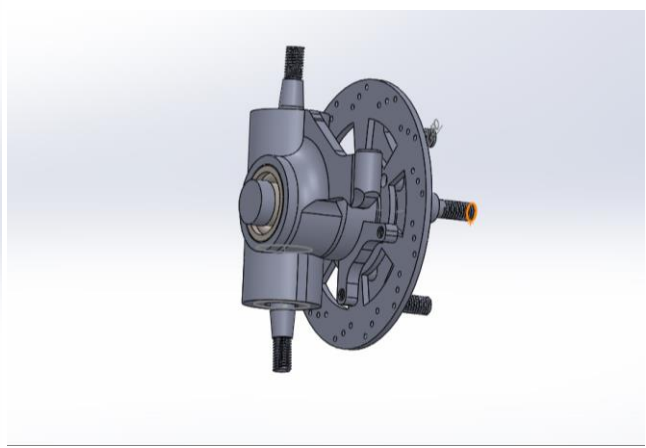


Fig 3.

2.3 Wishbone

The design of the wishbone, Fig 4, is symmetrical therefore can be used for the upper and lower positions and has a common width so the main body can be used front and rear with only slight changes to the mount for the axle. Below is the design for the front wishbone.

The material is 6063 aluminum due to its relative abundance in various stock forms. For instance, in order to manufacture the wishbone a milled section from a flat bar stock could be then welded to a tube of the correct dimensions turned in a lathe if required.

The design was to use a thin bronze bush material in the I.D. of the chassis mount in order to allow it to pivot around the pin however bearings could also be used with changes to the design however the load capacity of bushes is normally greater and the speed of the rotation relatively low, bushings being a lighter and easier method to manufacture.

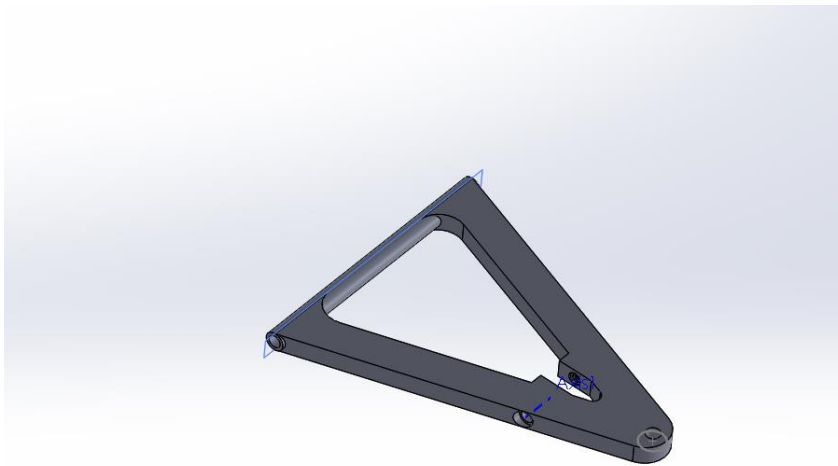


Fig 4.

3 Analysis

The wishbone is where the bulk of our analysis took place. The simulation feature in solid works was used during our analysis.

in order to use the simulation, the material was specified Fig 6, and a mesh within the solidworks drawing, Fig 7.

For the first simulation the fixtures were set so the wishbone was fixed where it mounts to the chassis and at the lower shock mount. This would be similar to the forces experienced if the shock absorber was to bottom out, these are also shown in figure 7.

A pin was used in the taper in this simulation in order to correct the direction of the load. Further research would need to be carried out to find an more accurate alternative

a load was then applied through the taper where the hub would mount and the load set to 1612N which is an approximation of the total combined weight of driver and vehicle supported by this one point. This is of course an unrealistic situation but by definition worst case.

The software deemed the amount of deformation in the part to be too great to be realistic so an error message was displayed.

The load was then lowered to 800N, which is almost realistic, being that the load in this direction would be supported by two wishbones but still requires the vehicle and rider to be resting solely on this point.

Shown below Fig, 8, is a visualization of the deformation and stress that would occur in the part. as shown the part would deform but at no point in the part yield.

The same fixture was then used at the chassis mount but applied a load of 500N through the mount for the shock absorber, which would be expected with a 10kg/mm spring at 25mm of suspension travel. Again a pin was used with a flat surface in the direction of the force desired was used, this was especially flawed as it omitted the threads in the wishbone.

With this simulation there were a few areas, shown below in Fig 9 and 10, which were of interest. Firstly, it put a large portion of the part into yield which may be accurate however errors in the locations of the fixtures could account for this, further work could be carried out on how the part would behave with the same loads but changing or removing the one fixture. Much of this stress may be reduced, especially in the filleted corners where the tube mounts to the rest of the wishbone.

Also on the underside of the shock mount there was an area of relatively high stress, indication there may be an issue with wall thickness around that bolt hole as well as the clearance used for the head of the bolt. An extrusion may have been a better solution as opposed to a recess.

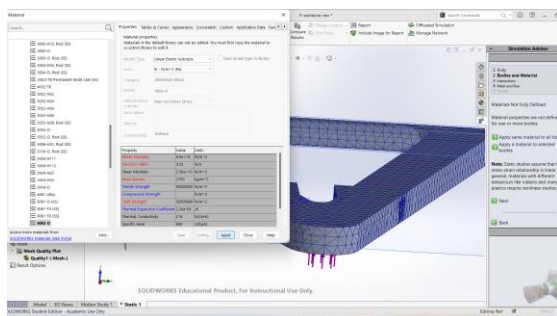


Fig 6, Material selection

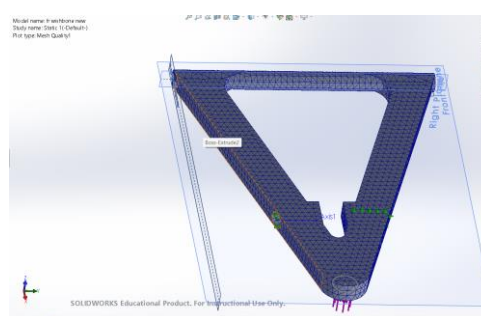


Fig 7, Mesh and loads/fixtures

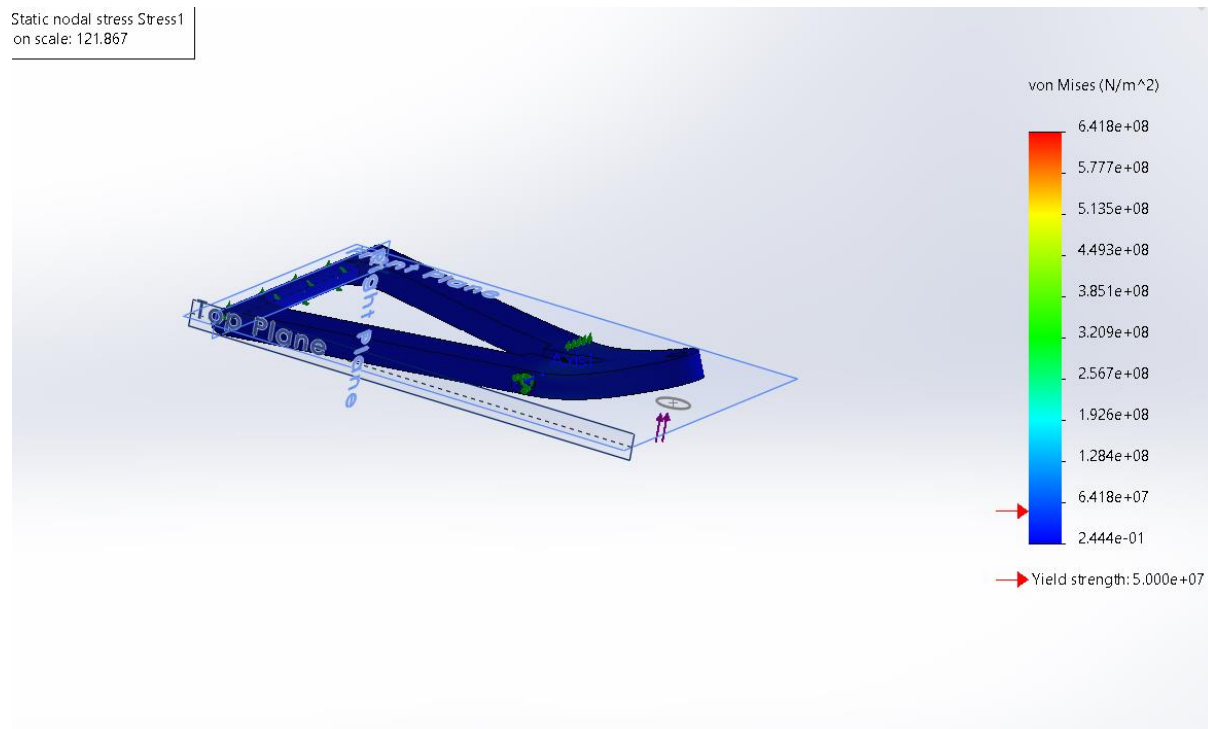


Fig 8, Deformation. Simulation 1 (stress)

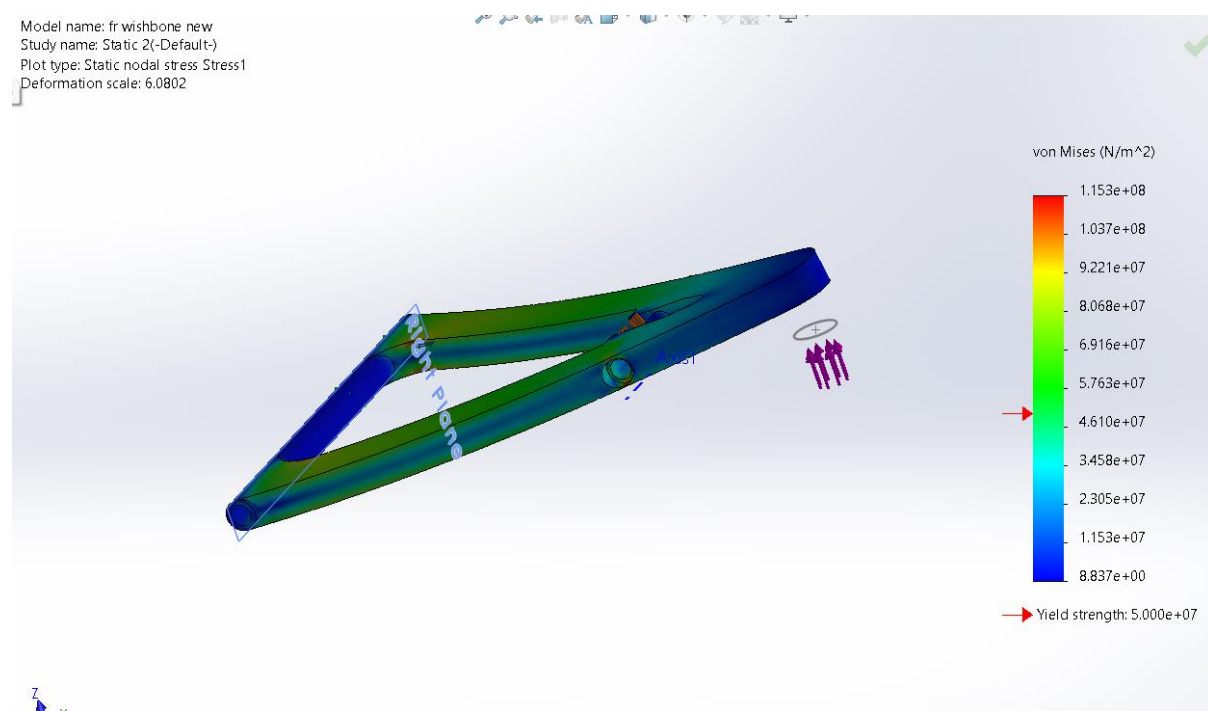


Fig 9, Simulation 2, stress overall view

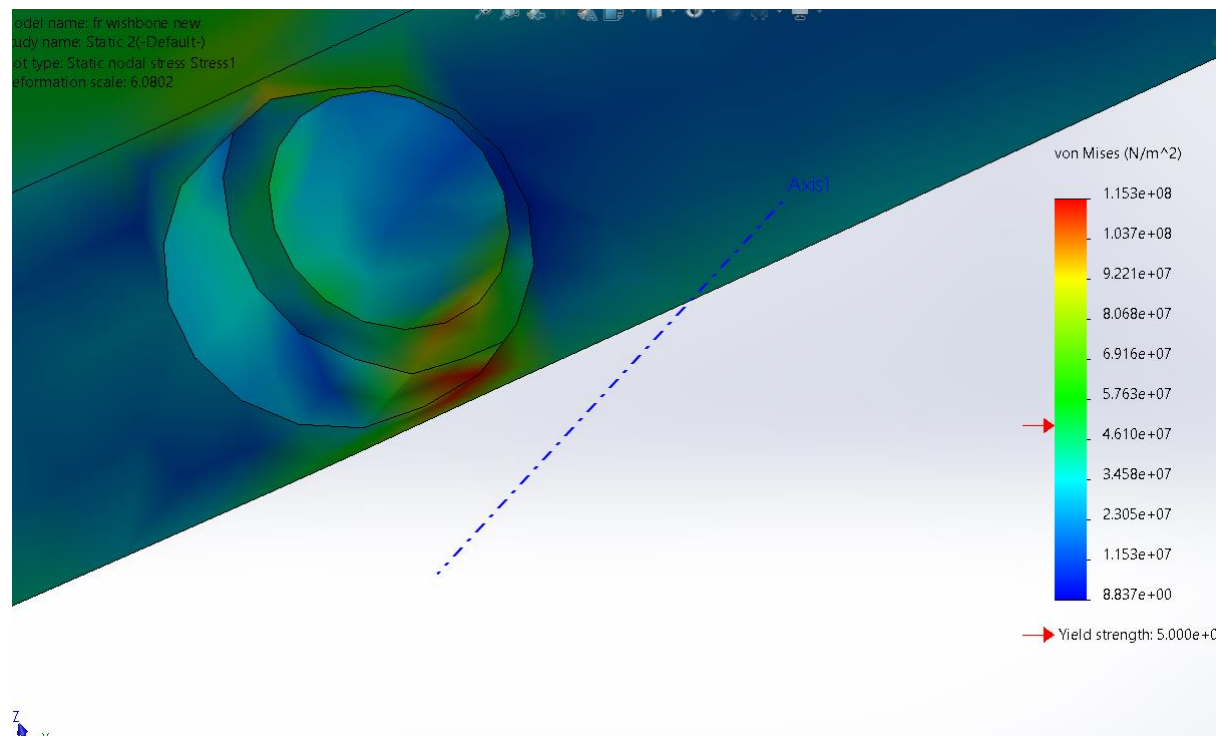


Fig 10, simulation 2, bolt pocket



RESULT

RESULT

ASSIGNMENT SPECIFICATION

Student name:		Student P number:	
Programme:	STEM Foundation year	School:	Engineering
Module:	Integrating Project	Module Level (4, 5, 6):	4
Module code:	ACHA4008	Contribution to Overall Module Assessment (%):	40
Lecturer:	Richard Sutton	Internal Verifier:	A Noble
Assignment Title:	Project second assignment	Assignment No (x of x):	2 of 2
Hand Out Date:	7/2/22	Submission deadline:	13/5/22

Referencing:	In the main body of your <u>submission</u> you must give credit to authors on whose research your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have read or quoted in order to complete this assignment (e.g. for books: surname of author and <u>initials</u> , <u>year</u> of publication, <u>title of book</u> , edition, publisher: place of publication).			
Disclosure:	I declare that this assignment is all my own work and that I have acknowledged all materials used from the published or unpublished works of other people. All references have been duly cited.			
Student's Signature:	<i>Michael Charity</i>	Date:	13/05/22	
Turnitin: Lecturer to tick to indicate if an electronic version of the assignment must be submitted to Turnitin. Note: <u>the</u> Turnitin version is the primary submission and acts as a receipt for the student. Both electronic and paper versions MUST be submitted by the same deadline. No marks will be released until both submissions are received. Late submission of either the electronic or paper version will result in a late penalty mark. Penalties for late submission: Up to one week late, maximum mark of 40%. Over one week late, Refer. Only Year Tutors and the Programme Director may grant an extension.			YES	x
			NO	

Learning Outcomes tested (from module syllabus)	Assessment <u>Criteria</u> To achieve each outcome a student must demonstrate the ability to:
Technical knowledge/skill	Final CAD drawings of the part designed in assignment 1
Analytical skills	Perform calculations to analyse forces (for example) that the part is going to endure
Quality of result and <u>evaluation</u>	Comment on the suitability of the design

- Please submit the assignment parts in a suitable report folder– ~~not~~ in ~~poly~~pockets.
- This form (ALL PAGES) MUST be at the front of the paper submission. Assignments will not be accepted without this form as it is a requirement that you sign the disclosure regarding referencing convention.
- DO NOT put this form into Turnitin or it will match many similarities with other students' submissions.

TASK DESCRIPTION

The second part of this module is where you provide a technical report (1000 words) and a group presentation (10 mins max) to showcase your final designs.

GUIDANCE FOR STUDENTS IN THE COMPLETION OF TASKS

Your group must write a report (1000 words) that showcases your final designs that you researched on for assignment 1 of the module. Include CAD drawings and an evaluation on the process of designing the product. Comment on the suitability of the design, the quality of the result, as well as aspects that could be changed or improved on.

The report must also include some form of analytics/calculations based on the part you have designed. This could be, for example, the forces that the frame will need to endure to function safely.

To complement the report, you will have to do a 10 minute (max) presentation, where you will professionally explain how the project went, any stumbling blocks, why you designed the 'soapbox' the way that it turned out, what would you change, how the group worked together, etc. **The dates of these will be supplied on Teams in due course (they will take place in May).**



MARKING CRITERIA AND STUDENT FEEDBACK

This section details the assessment criteria. The extent to which these are demonstrated by you determines your mark. The marks available for each criterion are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

Common Assessment Criteria Applied	Marks available	Marks awarded
1. Quality of designs	30	
2. Analytical work	30	
3. Quality of report	10	
4. Quality of presentation	20	
5. Professionalism	10	

Assignment Mark (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.)	Late Submission Penalties (tick if appropriate)		%
	Up to one-week late		
	Over one week late		

COMMON ASSESSMENT AND MARKING CRITERIA

	OUTRIGHT FAIL	UNSATISFACTORY	SATISFACTORY	GOOD	VERY GOOD	EXCELLENT	EXCEPTIONAL
Assessment Criteria	0-25%	30-35%*	40-45%	50-55%	60-65%	70-75%	85-100%
1. Research-informed Literature Extent of research and/or own reading; <u>selection</u> of credible sources, application of appropriate referencing conventions	Little or no evidence of reading. Views and findings unsupported and non-authoritative. Referencing conventions largely ignored.	Poor evidence of reading and/or of reliance on inappropriate sources, and/or indiscriminate use of sources. Referencing conventions used inconsistently.	References to a limited range of mostly relevant sources. Some omissions and minor errors. Referencing conventions evident though not always applied consistently.	Inclusion of a range of research-informed literature, including sources retrieved independently. Referencing conventions mostly consistently applied.	Inclusion of a wide range of research-informed literature, including sources retrieved independently. Selection of relevant and credible sources. Very good use of referencing conventions, consistently applied.	A comprehensive range of research-informed literature embedded in the work. Excellent selection of relevant and credible sources. High-level referencing skills, consistently applied.	Outstanding knowledge of research-informed literature embedded in the work. Outstanding selection of relevant and credible sources. High-level referencing skills consistently and professionally applied.
2. Knowledge and Understanding of Subject Extent of knowledge and understanding of concepts and underlying principles associated with the discipline.	Major gaps in knowledge and understanding of material at this level. Substantial inaccuracies.	Gaps in knowledge, with only superficial understanding. Some significant inaccuracies.	Evidence of basic knowledge and understanding of the relevant concepts and underlying principles.	Knowledge is accurate with a good understanding of the field of study.	Knowledge is extensive. Exhibits understanding of the breadth and depth of established views.	Excellent knowledge and understanding of the main concepts and key theories. Clear awareness of challenges to established views and the limitations of the knowledge base.	Highly detailed knowledge and understanding of the main theories/concepts, and a critical awareness of the ambiguities and limitations of knowledge.
3. Analysis Analysis, evaluation and synthesis; logic, argument and judgement; analytical reflection; <u>organisation</u> of ideas and evidence	Unsubstantiated generalisations, made without use of any credible evidence. Lack of logic, leading to unsupported/missing conclusions. Lack of any attempt to analyse, synthesise or evaluate.	Some evidence of analytical intellectual skills, but for the most part descriptive. Ideas/findings sometimes illogical and contradictory. Generalised statements made with scant evidence. Conclusions lack relevance.	Evidence of some logical, analytical thinking and some attempts to synthesise, albeit with some weaknesses. Some evidence to support findings/ views, but evidence not consistently interpreted. Some relevant conclusions and recommendations, where relevant.	Evidence of some logical, analytical thinking and synthesis. Can analyse new and/or abstract data and situations without guidance. An emerging awareness of different stances and ability to use evidence to support the argument. Valid conclusions and recommendations, where relevant.	Sound, logical, analytical thinking, synthesis and evaluation. Ability to devise and sustain persuasive arguments, and to review the reliability, validity & significance of evidence. Ability to communicate ideas and evidence accurately and convincingly. Sound, convincing conclusions / recommendations.	Thoroughly logical work, supported by evaluated evidence. <u>High-quality</u> analysis, developed independently or through effective collaboration. Ability to investigate contradictory information and identify reasons for contradictions. Strong, persuasive, conclusions, justifiable recommendations.	Exceptional work, judiciously selected and evaluated evidence. Very <u>high-quality</u> analysis, developed independently or through effective collaboration. Ability to investigate contradictory information and identify reasons for contradictions. Highly persuasive conclusions.
4. Practical Application and Deployment Effective deployment of appropriate methods, materials, <u>tools</u> and techniques; extent of skill demonstrated in the application of concepts to a variety of processes and/or contexts; formulation of innovative and creative solutions to solve problems.	Limited or no use of methods, materials, tools and/or techniques. Little or no appreciation of the context of the application.	rudimentary application of methods, materials, tools and/or techniques but without consideration and competence. Flawed appreciation of the context of the application.	An adequate awareness and mostly appropriate application of <u>well-established</u> methods, materials, tools and/or techniques. Basic appreciation of the context of the application.	A good and appropriate application of standard methods, materials, tools and/or techniques. Good appreciation of the context of the application, with some use of examples, where relevant. Evidence of some innovation and creativity.	A very good application of a range of methods, materials, tools and/or techniques. Very good consideration of the context of the application, with perceptive use of examples, where relevant. Evidence of some innovation and creativity.	An advanced application of a range of methods, materials, tools and/or techniques. The context of the application is well considered, with extensive use of relevant examples. Application and deployment extend beyond established conventions. Innovation and creativity evident throughout.	Outstanding levels of application and deployment skills. Assimilation and development of <u>cutting-edge</u> processes and techniques.
5. Skills for Professional Practice Demonstrates attributes expected in professional practice <u>including</u> : individual initiative and collaborative working; deployment of appropriate media to communicate (including written and oral); clarity and effectiveness in presentation and organisation.	Communication media is inappropriate or misapplied. Little or no evidence of autonomy in the completion of tasks. Work is poorly structured and/or largely incoherent.	Media is poorly designed and/or not suitable for the audience. Poor independent or collaborative initiative. Work <u>lacks</u> structure, organisation, and/or coherence.	Can communicate in a suitable format but with some room for improvement. Can work as part of a team, but with limited involvement in group activities. Work lacks coherence in places and could be better structured.	Can communicate effectively in a suitable <u>format</u> , and consistently in a suitable format. Can work very well as part of a team, with clear contribution to group activities. Mostly coherent work and is in a suitable structure.	Can communicate well, <u>coherently</u> and consistently in a suitable format. Can work very well as part of a team, with very good contribution to group activities. Work is coherent and fluent and is well structured and organised.	Can communicate professionally and, confidently in a suitable format. Can work professionally within a team, showing leadership skills as appropriate, managing conflict and meeting obligations. Work is coherent, very fluent and is presented professionally.	Can communicate with an exceptionally high level of professionalism. Can work exceptionally well and professionally within a team, showing advanced leadership skills. Work is exceptionally coherent, very fluent and is presented professionally.

Student Self Evaluation Form			
Student name:	Michael Charity	Student P number:	2100477
Programme:	Motorcycle Engineering	Year of programme	2021-2022
Assignment Title:	ACHA4008		

This section repeats in brief the common assessment criteria detailed on previous pages. The *extent* to which these are demonstrated by you determines your mark. Using these criteria, tick the box that best indicates the level of achievement you feel you have achieved with regard to each of them.

Common Assessment Criteria Applied	Level of Achievement						
	REFER		3 rd	2:2	2:1	1 st	1 st
	OUTRIGHT FAIL	UNSATISFACTORY	SATISFACTORY	GOOD	VERY GOOD	EXCELLENT	EXCEPTIONAL
1. Research-informed Literature	0-29%	30-39%	40-49%	50-59%	60-69%	70-79%	80-100%
	☐	☒	☐	☐	☐	☐	☐
2. Knowledge and Understanding of Subject	0-29%	30-39%	40-49%	50-59%	60-69%	70-79%	80-100%
	☐	☐	☒	☐	☐	☐	☐
3. Analysis	0-29%	30-39%	40-49%	50-59%	60-69%	70-79%	80-100%
	☐	☐	☐	☐	☒	☐	☐
4. Practical Application and Deployment	0-29%	30-39%	40-49%	50-59%	60-69%	70-79%	80-100%
	☐	☐	☐	☒	☐	☐	☐
5. Skills for Professional Practice	0-29%	30-39%	40-49%	50-59%	60-69%	70-79%	80-100%
	☐	☐	☒	☐	☐	☐	☐



PLEASE COMMENT ON AREAS IN WHICH YOU FEEL THAT YOU HAVE PERFORMED WELL	PLEASE COMMENT ON AREAS YOU FEEL THAT YOU NEED TO DEVELOP
Patients	Group choice

Student's Name		Date	
Student's Signature			