IN-COURSE ASSESSMENT (ICA) SPECIFICATION

Module Title: **Aeroengine and Rocket Science**	Module Leader: Module Code: **ENG2002-N**
Assignment Title:	Deadline Date: 4 Jan 2023 Deadline Time: **Submission Method:** Online (Blackboard) ☑ Middlesbrough Tower ☐

Online Submission Notes:

- Please follow carefully the instructions given on the Assignment Specification
- When Extenuating Circumstances (e.g. extension) has been granted, a fully completed and signed Extenuating Circumstances form must be submitted to the School Reception or emailed to scdt-assessments@tees.ac.uk.

Central Assignments Office (Middlesbrough Tower M2.08) Notes:

- All work (including DVDs etc) needs to be secured in a plastic envelope or a folder and clearly marked with the student name, number and module title.
- An Assignment Front Sheet should be fully completed before the work is submitted.
- When Extenuating Circumstances (e.g. extension) has been granted, a fully completed and signed Extenuating Circumstances form must be submitted to the School Reception or emailed to scdt-assessments@tees.ac.uk.

FULL DETAILS OF THE ASSIGNMENT ARE ATTACHED INCLUDING MARKING & GRADING CRITERIA

ENG2002-N Aeroengine and Rocket Science
Assignment 2020-21

This assignment forms 30% component of assessment for this module and, therefore assesses 3,4 and 5 module learning outcomes:

Research, Knowledge and Cognitive Skills:

1. Demonstrate a comprehensive and detailed knowledge and understanding of aeroengines and rockets and an ability to conduct thermodynamic and performance calculations.
2. Evaluate features of aeroengines and rockets and carry out associated analyses and calculations.
3. Analyse, interpret, and present technical data based on past and existing research in the Aerospace industry.
4. Analyse aeroengine and rocket problems to produce a workable solution.

Professional Skills:

5. Apply engineering skills related to jet engine and component performance with limited supervision and interpret results.

Marking Criteria

The standard Teesside University Level 5 marking criteria will be used:

Band	Level 5
90%-100%	Exceptional work with presentation of the highest standard. The work contains coherent arguments and ideas. There is a detailed understanding of subject matter and critical analysis of issues/problems. Points are made clearly and concisely, always substantiated by appropriate use of source material. There is evidence of a sound ability to critically interrelate theories with examples from practice where appropriate.
80%-89%	Outstanding work with presentation of a very high standard. There is comprehensive understanding of key concepts and knowledge and evidence of critical analysis and insight. Accurate interpretation of data with arguments, ideas and solutions presented effectively and based on strong research and reading.
70%-79%	Extremely good work with presentation of a high standard. Evidence of strong knowledge and understanding together with some critical analysis and insight. Source material is used effectively to support arguments, ideas and solutions.
60%-69%	Very good presentation. Sound knowledge and understanding with an emerging ability to critically engage with and apply the concepts involved linking them to practice where appropriate. Good use of source material which supports most points clearly. Content is wholly relevant and is coherently structured
50%-59%	Presentation is of a good standard but some shortcomings. Evidence of a sound knowledge base but limited critical and practical application of concepts and ideas. Content is largely relevant although points may not always be clear and structure may lack coherence. Contains some critical reflection and some use of source material to illustrate points.
40%-49%	Adequate presentation. The work is descriptive and/or lacks critical analysis where required but is relevant with limited though sufficient evidence of knowledge and understanding. There is some evidence of reading although arguments / proposals / solutions often lack

	coherence and may be unsubstantiated by relevant source material or partially flawed. Links to practice are made where appropriate
30%-39% – Fail	Poorly structured, incoherent and wholly descriptive work. Evidence of a weak knowledge base with some key aspects not addressed and use of irrelevant material. Flawed use of techniques. Limited evidence of appropriate reading and no evidence of critical thought. Little reference to practice where appropriate.
29% and below – Fail	Very poorly structured, incoherent and wholly descriptive work. Evidence of a very weak knowledge base with many key omissions and much material irrelevant. Use of inappropriate or incorrect techniques. Limited evidence of appropriate reading and no evidence of critical thought. No links to practice where appropriate.

1. Calculation & Analysis: Clear calculation and assumptions explanation, correct units and analysis **(50%)**

2. Discussion: Comprehensive review of literature relevant to study with a detailed knowledge of subject area demonstrated. Clear discussion of findings with logical conclusions based on evidence and a competent critical analysis. **(35%)**

3. Technical writing & Formatting: Clearly structured report with appropriate use of tables, graphs, diagrams and subsections, combined with appropriate technical writing. **(10%)**

4. Referencing: Excellent layout of references, properly mentioned in an order **(5%)**

Submission

The technical report is to be submitted online on Blackboard via Turnitin link under the assessment folder by 4 Jan 2023

Assignment

Data:

Symbols and abbreviations have their usual meaning unless specified otherwise:
1bar = 10^5 N/m^2
Patm = 1.01325x10^5 Pa
Air density = 1.2252 kg/m3

For air:

$\gamma = 1.4$, R= 287 J/kg.K, C_P= 1004 J/kg K

For the combustion products:

$\gamma = 1.3$, C_P= 1140 J/Kg K, R=283 J/kg.K

The Lower Calorific Value of hydrocarbon aviation fuel: h_{PR}= 45,000KJ/kg

Unless specified otherwise, turbomachinery efficiencies are isentropic.

A report of approximately 1200 words (+/-10% words) in length is required with comments and all the assumptions /calculation down for the analysis. The report should follow the technical structure with clear title, table of contents, figures, nomenclature, abstract, introduction, literature review, methodology, results and discussion and conclusion. The report is to be correctly formatted and referenced in accordance with the Harvard referencing system. Each student is to submit their own individual report via Turnitin which should be their work except were stated otherwise. If academic misconduct of any nature is suspected (e.g. plagiarism or collusion), it will be considered using the appropriate procedures as per the University regulation.

The following are the design parameters of a two-spool jet engine with a convergent nozzle at ISA Sea Level Static test rig:

Low Pressure Compressor (LPC) and High Pressure Compressor (HPC) pressure ratio: 5 and 10, Turbine Entry Temperature (TET) from 1400 to 1499K depends on your student number, Combustor pressure loss (% of Compressor outlet pressure) = 5 %,

Air mass flow rate =150 kg/s to the jet engine core, Include the fuel flow in your mass flow calculations.

Using the given data, please calculate and explain your results for a twin-spool jet engine.

1. Calculate the mass flow rates, pressures, temperatures through the jet engine inlet to exhaust.

2. Calculate the thrust, Specific Fuel Consumption (SFC), velocity, speed of sound and Mach number at the exit of the jet engine nozzle. Discuss whether the exit nozzle is choked or not?

3. What if the core jet engine is changed with a by-pass turbofan with by-pass ratio of 6 and fan pressure ratio of 1.5 is added to jet engine? What impact it will have on the thrust? Calculate the thrust with this design change and explain whether the turbofan will be fuel efficient compared to pure turbo jet engine.

4. Please populate the blank parameters in the below mentioned excel sheet (not the blocked red colour part) and include it at the start of the results section of your report.

SN	2	2.5	3	4	4.5	5	8
T(K)							
P(kPa)							
$\dot{m}$(Kg/s)							
A(m^2)							
V(m/s)							
F(N)							
M							
Density							
SFC(hr-1)							

List of student and respective Turbine Entry Temperature values

Name	Turbine Entry Temperature (K)
Jeevakrishnan Rao Vengadeswaran	1400
Zaynalov Farid	1401
Divya Ganesh	1402
Abdullah Bin Syed Ahmed	1403
Tao Yang	1404
Jeevakrishnan Rao Vengadeswaran	1405
Sathurappa Ramasamy Balaji	1406
Xing Zhe	1407
Lincoln Lim Li Gen	1408
Yap Zhao Tian, Dave	1409
Low Peng Jie	1410
Lim Sheng Fa (Lin Shengfa)	1411
Sean Ng Guan Rong	1412