



12 Pages

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

SURNAME: Carris

FORENAME(S): A. Curtis
ANOTHER.

1	Student Number	1706668
2	Title of Examination Paper	Advanced Strength + FEA (Part time)
3	Module Code	M6x00420
4	Date and Time of Examination	31-01-20 13.30
5	Examination Venue	
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
2	11
3	17
4	18
Total	46

(Gweler yr ochr arall am y fersiwn Cymraeg)

76.7%



Question 2.

a A crack may be initiated By:

Sharp corner ~~or~~ very small Filler, which could potentially cause a stress concentration.

A defect ~~within~~ the ^{material} ~~material~~, such as a slag inclusion.

Incorrect Heat Treatment applied to the part, not stress relieved ~~post~~ ~~the~~ welding.

Damage - Such as ^{a scrape or dent} ~~scrapped~~ during installation.

4

b Point of initiation

Arrest lines - corrosion as the crack propagates.

Crystalline area of the rupture.

3

c A fluctuating stress in the form of a cyclic load can be applied, the stress should be under the material's tensile strength and even under the material's elastic limit.

XO

1

d.

10^9

100 MPa

10^6

200 MPa

x

150 MPa

$$\frac{n_1}{N_1} + \frac{n_2}{N_2} + \frac{n_3}{N_3} = 1$$

$$\frac{10^9}{100} + \frac{10^6}{200} + \frac{x}{150} = 1$$

$$\therefore \frac{x}{150} = 1 - \left(\frac{10^9}{100} + \frac{10^6}{200} \right)$$

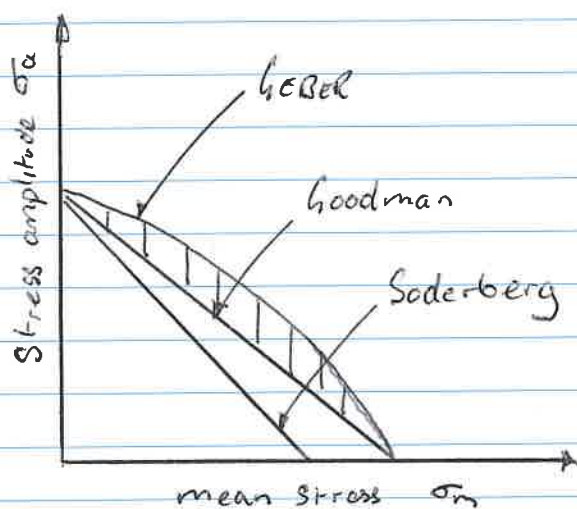
$$\frac{x}{150} = 100 - 0.5 \times 10^6$$

$$\therefore x = 100 - 0.5 \times 10^6 \times 150$$

$$= \underline{15.007 \times 10^9} \text{ cycles}$$

X

e



The majority of failures will result between Heber and Goodman (Shaded area). However Soderberg is generally used as it is more conservative.

4

- a An FEA is based on assumptions and calculations from point to point and node to node. If the mesh quality is poor then this will lead to questionable results.

The checks on mesh quality that can be undertaken include.

Mesh Size - The mesh size should be a trade off between accuracy and run time. However, for accurate results the mesh must be checked for convergence. This can be accomplished by reducing the size of the elements until the results converge to a similar value, i.e. by reducing the mesh size further, the values change are small. Most FEA Softwares provide an automated approach to this with H or P adaptive features.

Mesh Shape - The calculations (matrix) are calculated based on the assumption that the shape of the element has not been distorted in any way. Model geometry such as small fillets or sharp corners can skew or warp element to allow these element to fit within the geometry. An Aspect ratio check on elements compares element edges and provides or identifies any misshaped elements which can then be dealt with by altering the model geometry or by using mesh control to refine the mesh at these areas.

Element Duplicates - This can be a result of the CAD Geometry. During modelling of a component within a design space, a feature could be mirrored or copied and provide an overlapping surface. This would result in stiffer areas during analysis because

of the additional elements.

Element normals - This is also a result of the CAD Geometry.

12

6. Simple tools such as a DTI Gauge can be used to measure and compare the displacement. Or more advanced Strain gauges ^{or} Photoelastic techniques can also be used to measure the displacement. Results can be compared to material or mechanical hand calculations.
- loadcells Such as accelerometers can be use to measure the force.

5

Question 4

The FEA Process can be explained using the Acronym SIMPHE:

SPLIT - At this stage elements (1D, 2D or 3D), order (1st or 2nd) and density (size) have to be established and applied to the model.

Interpret - The model needs to be assessed to see if it can be simplified in any way to reduce the runtime to solve. This may involve removing small fillets or unnecessary features.

Material - A material must be applied to the FE Model which is the same as the part being analysed, otherwise the calculations will be incorrect.

Physical Properties - If 1D or 2D element are being used the physical properties must be defined to enable calculations, such as 2nd moment of area, etc.

Loading - The load and direction must be applied and any constraints need to be defined.

Evaluate - The analyst must evaluate the results and decide if any boundary conditions applied or defined are affecting his results. The FEA process is a computational system and like any other computational system - garbage in and garbage out.

The Steps SIMPL can be defined as preprocessing from above. Processing is the computational part of FEA. Evaluation can be considered as post processing.

6. Special techniques were ~~also~~ once popular ~~to~~ which reduced run time on large or complex models when computer capacity was ~~limited~~ ~~just~~ historically limited. An example of one of these techniques was to only analyse one side of a Symmetrical part and assume the other would ~~to~~ present the same results. This would obviously reduce run time, but also reduce the possibility of mesh errors and save time on mesh refinement through mesh control in certain areas of the FE model. Now, with the advancement of computer capacity and through automated meshing techniques, such as H or P Adaptive. The analysis can be run and other activities can be accomplished during this solve time. H or P Adaptive techniques use an Error norm to ensure elements next to each other do not have sudden ~~errors~~ changes in value. If sudden changes are found the techniques refine the mesh in these areas in an iterative process until Global values are reached.

^{and computer tech}
The advancement in ~~computers~~ ^{and computer tech} has ~~to~~ substantially reduced the runtime on FEA

The advancement in ~~Hard~~ Computer Hardware and Software has Substantially reduced the runtime on FEA. To such an extent that Analysts are now changing the way FE models are meshed. The ~~old~~ techniques to speed up run time are no longer required, as the ~~extra~~ time spent during mesh refinement is comparable to automatic meshing techniques. It could even be argued that automatic meshing is more efficient as it frees up the Analysts to perform additional studies.

Question No.

Examiner Or

Arholwr yn unig

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Question No.

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Question No.

Examiner On

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the 1990s, the number of people in the UK who are aged 65 and over has increased by 1.5 million, and the number of people aged 75 and over has increased by 1.1 million (Office for National Statistics 1999). The number of people aged 65 and over is projected to increase to 6.5 million by 2011, and the number of people aged 75 and over to 3.5 million (Office for National Statistics 1999).

There is a growing awareness of the need to develop services to meet the needs of older people, and a number of initiatives have been developed to address this need. The Department of Health (1999) has published a strategy for older people, which sets out the government's commitment to improve the lives of older people. The strategy is based on three main principles: (1) to ensure that older people have the opportunity to live independently and actively; (2) to ensure that older people have access to the services and support they need; and (3) to ensure that older people are treated with respect and dignity.

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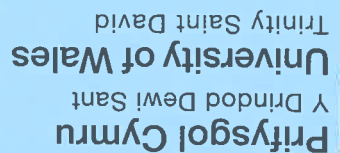
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12 Tüdalen

CYFENW:

ENW(AU) CYNTAF:

1. Rhaid i'r atebion fod mewn llawysgriften ddarllenadwy. Gall yr Arholwyr naill ai anwybyddu sgrïpt annarllenedadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.
2. Ysgrifennwch eich atebion mewn inc.
3. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell dryddyddnt.
4. Ni ddylid rhwygo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.
5. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyllw/gwylwyr.
6. Rhaid dychwelyd pob llyfr. Ni chaniateir mynd â llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arholi o dan unrhyw amgylchion.

[illegible]