



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

Examination Answer Books

12 Pages

Instructions to Candidates

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.

Complete, fold and seal
(see note 2 below)

SURNAME:

May-White

FORENAME(S):

William

1	Student Number	10973
2	Title of Examination Paper	Advance Strick FEA
3	Module Code	M6X00420
4	Date and Time of Examination	31/1/2020
5	Examination Venue	10002 S1A1
6	Seat Number	
7	Number of Answer Books handed in	

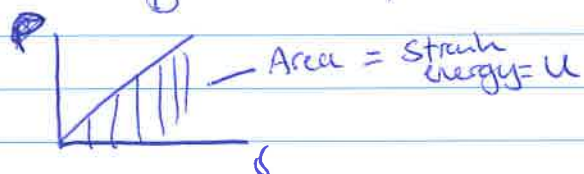
List the numbers of the questions you have attempted	Office Use
1	12½
2	8
3	12
Total	32½

(Gweler yr ochr arall am y fersiwn Cymraeg)

54.2%



Q1a) Strain energy is the amount of energy that a material has ~~on~~ resisting deformation when a load is applied. the resistance will come in the form of young's modulus (Stiffness) ~~seeing it is positive~~



$$b) \quad E = \frac{\sigma}{\epsilon}$$

$$E = \frac{PL}{\delta A}$$

$$E = \frac{\sigma L}{\epsilon}$$

$$\sigma = \frac{P}{A}$$

$$\delta = \frac{P \epsilon L}{EA}$$

$$\epsilon = \frac{\delta}{L}$$

c) As seen in a) graph $U = \frac{1}{2} P \delta$

Sub in δ into U

$$U = \frac{1}{2} P \frac{P \epsilon L}{EA}$$

$$U = \frac{P^2 \epsilon L}{2EA}$$

Integrate between $L \neq 0$

$$U = \int_0^L \frac{P^2 \epsilon}{2EA} \cdot ds$$

$$U = \left[\frac{P^2 \epsilon L}{2EA} \right] - \left[\frac{P^2 \epsilon 0}{2EA} \right]$$

$$\therefore U = \frac{P^2 L}{2EA}$$

d) Resilience is the amount a material resists deformation at B per unit Volume. $\therefore$ Resilience = Strain energy per unit Volume = $\frac{U}{V}$

$$e) \frac{\sigma^2}{2E} = \frac{U}{V}$$

$$P = \sigma = \frac{P}{A}$$

$$\therefore P = \sigma A$$

$$U = \frac{P^2 L}{2EA}$$

Sub in B.O.A

$$U = \frac{\sigma^2 A^* L}{2EA}$$

$$V = A \times L$$

$$U = \frac{\sigma^2 V}{2E}$$

$$\therefore \frac{U}{V} = \frac{\sigma^2}{2E}$$

f) $10^{-6} (15 \times 15) \times 1 \text{ m}^3$ $\sigma = 200 \times 10^6 \text{ Pa}$

$$U = \frac{(200 \times 10^6)^2 \times ((15 \times 15) \times 10^{-6}) \times 1}{2 \times 200 \times 10^9 \times \text{AREA?}}$$

assuming $= \sigma -$
 $E = \frac{\sigma}{\epsilon}$

$$U = 22.5 \text{ J}$$

$$E = \frac{\sigma L}{\delta}$$

assuming

g)



+

Q2a) ~~Stress~~ high stress points in geometry ~~as~~ such as edges, fillets etc. & high stress levels than intended.

~~Material~~ Material imperfections which would lead to material properties not working as intended.

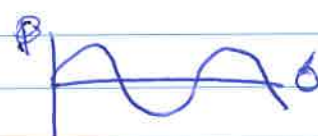
Corrosion of material reducing strength etc

Excessive wear gone past known fatigue cycles limits. But below the yield limit and Max Stress. X

5) - Initiation of fatigue such as a crack. where this is where a crack will start to form and with load cycles will increase the size and promote failure.

- Propagation / arrest line where the material will start to break!

- Crystalline where the part will have ~~eff~~ crystallisation on surface due to material properties starting to deteriorate. X

- c) By this could be done by plotting the extension bending at an axis point. It will produce a Sine wave such as is shown below the bar when rotates around it axis will change shape.
- 

d) $\sigma_a^N N_f = k$

σ_a = Stress amplitude
 N_f = No Cycles to failure

$$\begin{aligned} (100 \times 10^6)^a \times 10^9 &= k \\ (200 \times 10^6)^a \times 10^6 &= k \\ (150 \times 10^6)^a \times ? &= k \end{aligned}$$

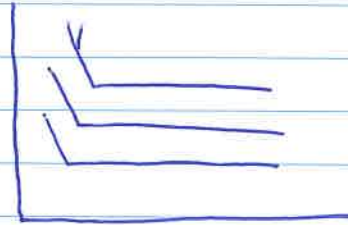
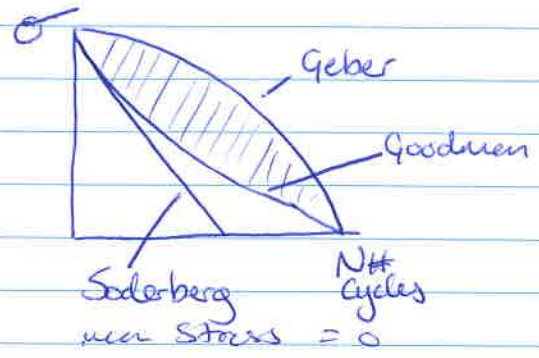
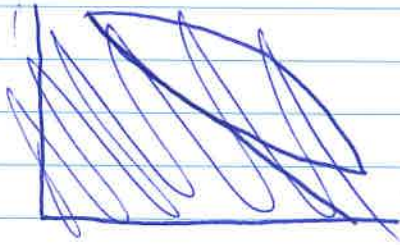
$$\begin{aligned} a \log(100 \times 10^6) \times \log(10^9) &= \log 1 \times 10^{17} = 1.0177 \\ a \log(200 \times 10^6) \times \log(10^6) &= \log 2 \times 10^{14} = 0.1771 \end{aligned}$$

$$a \left(\log(100 \times 10^6) \times \log(10^9) \right) = 8.42 \times 20.72$$

$$\begin{aligned} (100 \times 10^6)^a \times 10^9 &= (200 \times 10^6)^a \times 10^6 \\ a \log(100 \times 10^6) \times \log(10^9) &= a \log(200 \times 10^6) \times \log(10^6) \\ 381.73a &= 264.06a \end{aligned}$$

at back of paper:

Q2 e)



2

Q3)

a) Mesh size has a direct influence of the accuracy and validity of your results. First it is a trade off of accuracy and time. Smaller mesh = better results but longer solve time. Larger mesh = less accurate results however shorter solve time.

- Selecting correct mesh size, it is important that the elements size is selected accordingly otherwise they may overlap and not give good results for instance if a element size is from the surface of a part to the neutral axis then the surface side will be in high tension/compression and at the neutral axis there these will be very little.
- Element shape. the shape of the elements are important. if they are not perfectly shaped then this will reduce the accuracy of results. But elements will change shape to satisfy geometry.
- Overlapping mesh - if two elements overlap in mesh due to surface being in contact but in the real part it is a solid body. this will reduce accuracy and probably make study invalid.
- Mesh order will give better such as first order & second order. the more nodes available in second order will give better results.

The checks to be carried out should be element shape. this can be changed in mesh setting by aspect ratio of elements. Elements of high concentration at fixed points will be under extreme load due to stressors be infinite.

12

b) ~~Test~~ FEA tools that can be used are

Dynamic ~~loads~~/static loading - to see stress levels and deformation/extension values.

Fatigue - to see how many cycles a part will fail at.

Buckling - where a part will buckle

Thermal - Properties change at different ~~temperatures~~ temperatures

NVH - Noise, vibration and harshness - to see how the part reacts under conditions.

All these ~~part~~ tools can give an approximation of failures. This should be correlated to physical test to ensure results are correct.

Then these test ~~depend~~ depend on the analysis type such as linear and non-linear. If a part

X

Q2d) $\sigma_r N_f = k$

$a = ?$
 $k = ?$

~~100~~

Units in
MPa

① $100^a \times 10^9 = k$

② $200^a \times 10^6 = k$

① $a \log(100) \times \log(10^9) = \log k$

~~$a = \frac{\log(k)}{\log 100 \times \log 10^9}$~~

$a = \frac{\log(k)}{\log 100 \times \log 10^9}$

Sub ① into ②

~~$\frac{\log(k)}{\log 100 \times \log 10^9} \times \log 200^a \times \log(10^6) = k$~~

$\frac{\log(k)}{\log 100 \times \log 10^9} \times \log 200^a \times \log(10^6) = k$

~~$\frac{\log k}{\log k} = \frac{\log 200 \times \log 10^6}{\log 100 \times \log 10^9}$~~

$k = 0.7672 \times 10^{-3}$

Sub k in to 21

$a = \frac{\log 0.7672 \times 10^{-3}}{\log 100 \times \log 10^6}$

X

Question No.

Examiner On

Arholwr yn unig

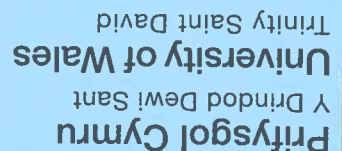
rtif y Cwestiwn

Question No.

Examiner Or

Arholwr yn unig

iff y Cwestiwn



12 Tüdalen

1. Rhwch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhwch eich enw yn y lle a ddarparwyd ar y dde, plygwch ef a'i selio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.

3. Rhaid i'r atebion fod mewn llawysgrifen ddarllenadwy. Gall yr Arholwyr naill ai anwybyddu sgrïpt annarllenadwy, neu drefnu iddi! gael ei theipio a chael yr ymgeisydd i dalu.

4. Ysgrifennwch eich atebion mewn inc.

5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw tras nodiadau yn y llyfr atebion a thynnwch llinell drwyddynt.

6. Ni ddylid rhwgo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.

7. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyllywr/gwylwyr.

8. 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 amgylchiadau.

7	Nifer y Llyfrau Atebion a gyflwynwyd	
6	Rhif Sedd	
5	Lleoliad yr Arholiad	
4	Dyddiad ac Amser yr Archoliad	
3	Cod y Modwl	
2	Teitl y Papur Arholiad	
1	Rhif Myfyrwr	

(See the other side for English version)

[illegible]

Llenwch, plygwrch a seliwrch
(gweler nodyn 2 isod)

CYFENW:

ENW(AU) CYNTAF:

ENW(AU) CYNTAF: