Exam Ae2-600 Aerospace Materials and Manufacturing 2

Delft University of Technology

January 28 2008, 9:00 – 12:00

General remarks and instructions (READ THIS FIRST)

- This is a closed book exam, so it is not allowed to consult the book, the reader or your lecture notes during the exam.
- This exam contains 10 multiple choice and 12 open questions.
- The answers on the multiple choice questions must be written on the answer form (last page). Those are the only ones considered.
- Do **not** detach the last page, since it is lost easily in such a case.
- Give short answers in the space following the question.
- You may also use the last but one pages if more space is required, but indicate when you use this page.
- Do not forget to give your name and study number on each page.
- Only use the English or Dutch language to answer the questions

Name _____

Study number _____

QUESTION 1

	What is a casting factor? (one answer)
a)	A safety factor, originating from uncertainties in material properties
b)	A safety factor, which must be added to the existing safety factor.
c)	The clearance angle of a work piece
d)	The increase of the mould cavity to compensate for shrinkage

QUESTION 2

	Feeling for numbers: Which of the following statements is true? (more answers possible)
a)	Carbon fibres are much stronger then glass fibres
b)	Aluminium alloys can be stiffer then steel alloys
c)	Carbon composites can be stiffer then aluminium alloys
d)	Steel alloys are stiffer then glass fibre composites.

QUESTION 3

	The Fokker XII  (more answers possible)
a)	has a comparable structural concept as the DC-2
b)	has a comparable structural concept as the Mosquito
c)	has a pressurised fuselage
d)	has a wooden wing

QUESTION 4

	Quality policy is: (one answer)
a)	The overall intentions and direction of an organisation with respect to quality, as formally expressed by top management.
b)	The activities that establish the objectives and requirements for quality and for application of quality system elements.
c)	The operational techniques and activities that are used to fulfil requirements for quality
d)	The organisational structure, procedures, processes and resources needed to implement quality management

QUESTION 5

	Which of the following statements is certainly true? (one answer)
a)	Parts inspected during production need not always be inspected in-service.
b)	Damage tolerant parts never have to be inspected in-service.
c)	Safe-life design parts are never inspected.
d)	Parts inspected during production are also inspected in-service.

QUESTION 6

	Which of the given rankings is the best regarding allowable pressure and allowable temperature of the following processes (from high to low): 1) Investment casting 2) Permanent mould casting 3) Resin transfer moulding 4) Injection moulding (one answer)
a)	Pressure: 4,3,2,1 Temperature: 2,1,3,4
b)	Pressure: 4,2,3,1 Temperature: 2,1,4,3
c)	Pressure: 4,3,2,1 Temperature: 1,2,4,3
d)	Pressure: 4,2,3,1 Temperature: 1,2,4,3

QUESTION 7

	One of the deformation mechanisms for Fibre Reinforced Composites is the intraply shear (Trellis effect). Which of the following statements about this mechanism is FALSE? (one answer)
a)	The in-plane deformations are always a combination of stretching and compression
b)	The thickness of the laminate remains constant during this deformation
c)	The laminate is not capable of biaxial straining
d)	For Thermoplastics the Trellis effect is activated above the glass transition temperature (T_g).

QUESTION 8

	Rubber forming is very attractive for the aerospace industry because: (the best answer)
a)	The large product variety the process can handle
b)	The cheap tooling costs
c)	The low production costs per part
d)	The ability to create global shape and details in one stroke

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QUESTION 9

	There are a number of reasons for the necessity of the assembly of structures. Which combinations are correct? (one answer)
a)	Material costs and size of the parts
b)	Risk share and different materials
c)	Accessibility and movement of substructures
d)	Political reasons and (un)employment
e)	Stakeholders interest and delivery interval

QUESTION 10

	Value creation in the concept of Lean Manufacturing means: (one answer)
a)	Adding value to the product by adding more material to the part
b)	Increasing the value of the product by activities like forming, casting, transport, and depreciation.
c)	Increasing the value of the part by manufacturing activities
d)	Increasing the price of the product.

QUESTION 11

	Superplastic forming is based upon a different principle than plastic forming.
a)	Give a brief description of the superplastic deformation principle
b)	"The achievable large strains can have a positive effect on the tooling costs". Explain this statement.
c)	Not all metal alloys can be superplastically formed. Describe one reason why a metal alloy cannot be deformed superplastically.

Answer 11

a)
b)
c)

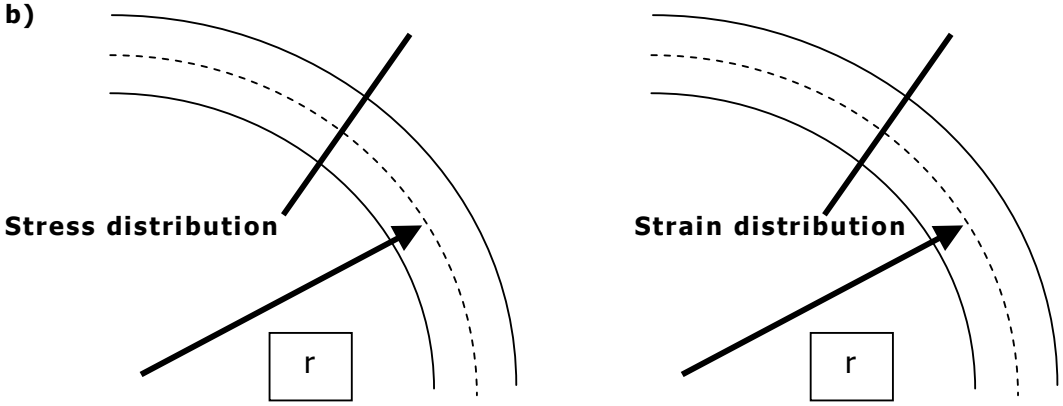
QUESTION 12

	For the bending we apply a number of assumptions to simplify the problem.
a)	Mention two assumptions and explain the meaning of them.
b)	Make sketches of the strain distribution and stress distribution in a cross section in a bend zone (see figure)
c)	The bend zone is divided in elastic and plastic areas. Make a sketch of these areas.
d)	Derive an expression for the maximum strain in the bend zone, given the thickness t and the bend radius r.

Answer 12

a)

b)



c)

d)

QUESTION 13

	An assembly jig should have a number of features/properties.
a)	Mention at least two features and give a brief explanation of each of them
b)	Make a sketch of (or describe) a typical structure as used for assembly jigs and explain why they use this type of structure.
	"Hole-to-hole assembly requires high accuracy of the entire production process".
c)	Explain this statement for the manufacturing processes of parts and the assembly process.
d)	Is the hole-to-hole assembly principle easier for metal structures than for composite structures? Explain your answer.

Answer 13

a)
b)
c)
d)

QUESTION 14 & Answer 14

	Give a brief description/definition of the following key words:
a) Batch:	
b) Delivery interval:	
c) Shunt:	
d) Station:	
e) Learning curve:	

QUESTION 15

	Bolting
a)	When are bolts applied as joining elements in a structure?
b)	Explain briefly the principle of a pre-stress in a bolt.
c)	Sometime the holes where the bolt has to be installed are plastically deformed before the bolting process. Why?

Answer 15

a)
b)
c)

QUESTION 16

	Give a brief answer and a reason which field is best suited for automated inspection: production or in-service?

Answer 16

QUESTION 17

	Extrusion
a)	What is the use of the shape factor (perimeter divided by cross sectional area)?
b)	Give the two methods to create a hollow extrusion.
c)	Why are extruded products often aluminium alloys and not steel alloys? Explain the answer.

Answer 17

a)

b) 1)

b) 2)

c)

QUESTION 18

	Composite manufacturing
a)	Why would you like to avoid an autoclave cycle in a process?
b)	Name one advantage of using an autoclave cycle in a process.
c)	Why is it expected that the use of thermoplastic composites compared to the use of thermoset composites will increase?
d)	What can you say about the fibre path when for all windings yield $R\sin(\alpha)$ = constant, with α being the winding angle?.

Answer 18

a)
b)
c)
d)

QUESTION 19

	Machining
a)	Give three functions of the fluids applied during machining processes.
b)	Explain the difference in cutting tool geometry of the cutting tools applied in turning and in grinding

Answer 19

a)
b)

QUESTION 20

	Processes like laser beam cutting, abrasive water jet cutting and punching can be applied to create a square hole, dimensions 10 mm by 10 mm, in an aluminium sheet of 2 mm thickness.
a)	State two other processes which you can apply to create a square hole, dimensions 10 mm by 10 mm, in an aluminium sheet of 2 mm thickness.
b)	Which of the processes mentioned in the heading and your answer to question a) do you expect to be the most expensive in tooling cost? Motivate your answer
c)	Why is the process mentioned in b) applied in some cases?

Answer 20

a)
b)
c)

QUESTION 21 & Answer 21

	Describe the principle of the investment casting process, use no more than 100 words.

QUESTION 22 & Answer 22

	Give a short definition of the following items. Name a process in which each item is used.
a) Riser:	
b) Peelply:	
c) Rake angle:	
d) Void:	
e) Billet:	

Question number	Additional space for answers Indicate in the original answer box that you used this page

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Answer sheet

Mark ☑ or ☒ or ■ or ☺ or ▨

Invalidate by drawing a circle around the box ⊘

	Answer / Question	A	B	C	D	E
	1	☐	☐	☐	☐	
	2	☐	☐	☐	☐	
	3	☐	☐	☐	☐	
	4	☐	☐	☐	☐	
	5	☐	☐	☐	☐	
	6	☐	☐	☐	☐	
	7	☐	☐	☐	☐	
	8	☐	☐	☐	☐	
	9	☐	☐	☐	☐	☐
	10	☐	☐	☐	☐	