Exam Production of Aerospace Systems

Code: AE 3321-II - **Closed Book Exam**

Date: Wednesday, August 12, 2015, 9.00-12.00; Lecture room J, AE

15 Multiple Choice questions and 4 Open questions

Read carefully - write in clear script – give concise answers

Text of the reader & slides is leading

Multiple Choice Questions

(1 alternative per question – 3 points per MC question)

Question 1.

The transition from tubes, wires and wood to full aluminium aircraft was hampered by a number of difficulties. Which difficulty did not influence the transition?

a) The properties of the new material
b) The skills of the labour force
c) The wing profiles needed for metal structures
d) The joining methods during assembly

Question 2.

There is a strong relationship between the “material”, the “manufacturing process” and the “design/shape” (so-called trinity concept). Which statement is false:

a) The melting of metal alloys is directly related to casting, welding and extrusion processes
b) The limited formability of cross-ply composites does not prevent the manufacture of 3D components
c) 3D shapes for thermoset composites are feasible by resin infusion processes
d) An important advantage of superplastic forming is the high complexity of the fabricated parts.

Question 3

What is meant with “nesting” during cutting operations?

a) The active removal of chips and other cutting debris
b) The lubrication itself, used for easy cutting, cooling and chip removal
c) The arrangement of blanks in the sheet to optimise the use of material
d) None of the above alternatives is true

Question 4

In shearing and punching the cutting edges do have some angle to the workpiece. Why?

a) The eliminate the burr that might exist otherwise
b) To reduce the cutting force
c) To improve the quality of the cutting edge
d) There is no specific reason for the angle

Question 5

During casting often “shrinkage allowance” is applied. What is meant with “shrinkage allowance”?

a) The extra volume of the riser to compensate for shrinkage
b) The material that has to be cut away after cooling of the casting
c) The adjustments in the design to obtain smooth transitions at thickness steps
d) The 1-2 % increase in dimensions to compensate for shrinkage

Question 6

Below there are four combinations of materials and a manufacturing process. Which combination is not correct:

a) Metal alloy and Superplastic Forming
b) Short fibre composites and Injection Moulding
c) Long fibre thermoplastic composite and Compression Moulding
d) Continuous fibre composite and extrusion

Question 7

Product features and properties can be of help for the selection of the right manufacturing process. Which feature or property cannot be used for the selection?

a) The shape of the component
b) The failure strain of the material
c) The ultimate strength of the material
d) The size and thickness of the component

Question 8.

One of the bulk forming processes is Forging. Usually forging is performed at elevated temperatures. Why?

a) To reduce spring back
b) To have a better formability
c) To reduce the press force
d) To form and heat treat the material simultaneously

Which answer is the best?

Question 9.

What are the differences between Vacuum Injection (VI) and Resin Transfer Moulding (RTM)? Which argument is false?

a) VI has one rigid tool and one flexible; RTM has two rigid tools.
b) RTM is better suited for components with a high accuracy
c) Due to its vacuum, the flow front in VI moves faster than in RTM
d) VI is easier for the manufacture of large components

Question 10

When preloading bolted joints, what is the aim of the pre-loading?

a) To reduce the maximum stress level in the joint
b) To reduce the stress amplitude of the fatigue load
c) To reduce the average stress of the fatigue load
d) To decrease the minimum stress level in the joint

What is the correct answer?

Question 11

The maximum applicable load of a bonded joint increases when:

a) the overlap length of the bond increases
b) the thickness of the bond line increases
c) the failure strain of the adhesive decreases
d) the shear stiffness of the adhesive decreases

Question 12

What is the most important feature of an assembly jig? Select the best answer!

a) The accessibility of the jig
b) The costs of an assembly jig
c) The stiffness of the jig
d) The strength of the jig

Question 13

A process focused quality assurance system

a) Focusses on the performance of manufacturing processes
b) Applies quality control of the part after every part manufacturing step
c) Applies quality control on the final part
d) Involves Non-Destructive Testing and non-conformity reports

Question 14

Which statement about Lean Manufacturing is correct?

a) The value of the process is determined by the shareholders
b) Waste can be divided in activities that can be eliminated and activities that cannot be eliminated
c) Waste can be related to some kind of spoiling of materials
d) JIT is an utopian concept; it cannot be realised on a large nor on a small scale

Question 15

" Organisational structure, procedures, processes and resources needed to implement quality management" is the definition of:

a) Quality control
b) Quality policy
c) Quality planning
d) Quality system
e) Quality assurance

Open Questions

(4 points each sub-question)

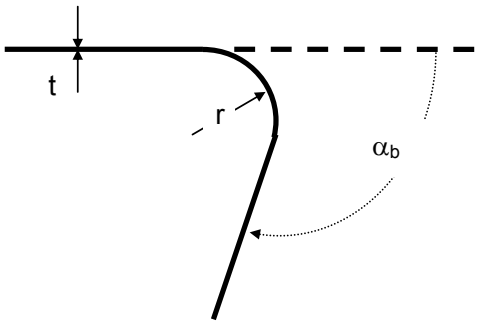
Question 16 - Tooling

a) Describe briefly what is meant with "universal" tooling and what is the opposite of "universal" tooling?
b) Is it possible to create parts with two soft tools only? Explain your answer.
c) Why is a set of matching dies much more expensive than a tooling set for rubber forming?
d) What is the relation between the costs of tooling and the product series?

Question 17 - Spring back

Spring back is a phenomenon that occurs e.g. during bending (See sketch)

a) What happens with the bend angle (α_b) due to spring back: Is the angle after spring back larger or smaller? Explain.
b) What about the radius: Does the radius increase or decrease? Explain.
c) Is there a relationship between the radius and the angle? If yes, which relationship?



Question 18

Line production is the leading production principle in the aircraft industry.

a) Give a brief description of the following entities: “learning curve”, “delivery interval”
b) What is the main reason to increase the number of shifts in the production? Explain your answer.
c) What, from a workers’ perspective, are the advantages of line production over mass production (as used in the automotive industry)?
d) What are the key features of a “station”?

Question 19 - Non-Destructive Testing

a) Is the following statement true or false; explain your answer: “Non-destructive testing becomes more important when the aircraft industry applies more fiber reinforced polymers in aircraft structures”.
b) What will be the most important defects (at least two) in fiber reinforced polymers? Explain your answer.

Success