Exam Production of Aerospace Systems

Code: AE 3321-II - **Closed Book Exam**
Date: Tuesday, April 14, 9.00-12.00; 2C Rooms 1 and 2
5 Open questions and 15 Multiple Choice questions
Read carefully - write in clear script (no pencil) – give concise answers

Multiple Choice Questions

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

Question 1.

To have the most benefit from the learning effect during assembly, the following assembly line features are essential:

a) The batch size should be limited; the number of workers in the station should be constant
b) Each station should have the same work, the same crew, and the same time
c) For all stations: the same delivery interval, the same work package sizes, and same crew numbers
d) For all stations: flexibility of delivery interval and work packages, same crew numbers

Question 2.

What is meant with an "80%" learning curve?

a) The working hours for Aircraft serial number 2N is 80% of the hours needed for serial number N
b) The throughput time for Aircraft serial number 100 is 80% of the time required for serial number 50
c) The delivery interval for Aircraft serial number 2N is 80% of the delivery interval for serial number N
d) The throughput time for Aircraft serial number N is 80% of the time needed for serial number 2N

Question 3

Which of the following statements about repeatability and predictability is true?

a) The concepts of repeatability and predictability are identical
b) Repeatability is usually limited to the manufacture of the same product series
c) Predictability has a strong relationship with the understanding of the process
d) None of the above alternatives is true

Question 4

Which of the following statements about joint design is true?

a) During the design of the joint, the focus should be on the selection of the right sheet materials
b) Optimization of a joint is aiming for (nearly) the same failure load for different failure modes
c) For all joints: joint strength is linearly proportional to the size of the joint
d) There are two main categories: tension/butt joints and overlap/shear joints

Question 5

What is the best definition for "adding value" as used in Lean Manufacturing?

a) "Adding value" = all activities during the production process where the material is processed
b) "Adding value" = all activities from the start to the end of the manufacturing process
c) "Adding value" = all activities performed on the product where the value of it is increased

d) “Adding value” = all non-waste activities during the process and the production of the part

Question 6

Most Non-Destructive Test methods are linked to a material property. Which combination is not correct:

a) Radiography – mass/density
b) Ultrasonics – speed of sound
c) Dye penetrant – visual contrast
d) Tap testing – audible sound

Question 7

About the Non-Conformity report is related to Quality control. What information is not relevant for such a report?

a) Giving an overview of the product and the detected flaws
b) Indication (and details) of the applied Non-destructive test method
c) The Life Data Sheet, describing all steps before the quality control
d) Economic parameters, like values, prices and hours spent on the product

Question 8.

The following statements are about Non Destructive Testing of structures:

I. In general, there are two main categories: methods which allow the inspector to look inside the material and methods which allow to inspect the surface of the product
II. Eddy current is an NDT method applicable to inspect both metal and composite parts

a) Both statements are true.
b) Statement I is true but statement II is false
c) Statement I is false, but statement II is true
d) Both statements are false.

Question 9.

When we compare metals and composites, the following statements are made. Which statement is false?

a) The trinity concept is more important for metals than for composites
b) For weight comparisons we have to look at structural level not at material properties only
c) The material transition from metals to composites is (to some extend) comparable with the material transition in the 1930s
d) Metal technology has fully developed whereas composites are still under development

Question 10

For proper punching of metals the following measures are to be taken

a) The clearance between punch and die should be within a specific range (not too small/not too large)
b) The punch edges should have an angle to the surface of the work piece material
c) The process needs abundant cutting fluids for reducing tool wear and chip removal
d) Punching is not an appropriate process for the nesting of products

Which is the incorrect measure?

Question 11

In injection moulding of thermoplastic polymers (no fibres) which flaw/feature indicates the mould division line?

a) A knit line.
b) The sprue
c) The flash
d) A sink mark

Question 12

Which of the following statements about adhesive bonding is true?

a) Adhesive bonding for thick adherents requires thicker bond lines
b) Adhesive bonding for final assembly is no option because of the required small tolerances
c) For the design of a bonded joint you need to know the maximum shear stress of the adhesive
d) The bath-tub-shape is created by the flexibility of the adhesive

Question 13

Which of the following statements about manufacturing with thermoplastic and thermoset composites (short to continuous fibres) is correct?

a) The deformation mechanism for thermoset and thermoplastic composites is different
b) For both polymer systems the order of impregnation and shaping can be reversed
c) Thermoplastic and thermoset composites can be manufactured with the same processes.
d) After curing of thermoset composites, further processing is feasible above the glass transition temperature Tg

Question 14

What is the Break Even Point of an aircraft program?

a) It is the aircraft number at which the total revenues equals the total costs
b) It is the point in time where the total revenues equals the total investments
c) It is the point in time where the profits become equal to the total costs
d) It is the aircraft for which the costs and revenues are equal

Question 15

Which of the following features is not related to water jet cutting:

a) High pressure
b) Abrasive particles
c) High temperature
d) Hard metal Orifice

Open Questions

(4 points each sub-question)

Question 16

In casting processes you may have expandable moulds and permanent moulds.

a) Mention at least two advantages or disadvantages of expandable moulds and explain your answer briefly
b) Name at least one process that uses expandable moulds and explain what the benefit(s) is/are for that process/mould combination.
c) Give at least two design rules you would use for permanent moulds and explain your answer briefly.

Question 17

In metal forming operations you can divide the deformations in irreversible or permanent and reversible or recoverable deformations.

a) Describe briefly how the irreversible/permanent deformations are created in metal microstructures
b) What is the cause for the reversible/recoverable deformations?
c) What is the biggest disadvantage of the reversible deformations? Explain your answer.
d) Do casting processes also encounter recoverable deformations? Explain your answer.

Question 18

There are two ways to organise quality control: product focused and process focused.

a) Describe the difference between these two concepts.
b) What quality control activities can be performed during the manufacture of a composite wing panel (mention at least 3 activities).
c) Describe briefly the role of the Airworthiness Authorities in the quality control process of the manufacturing of aircraft.

Question 19

For the calculation of the joint strength of a riveted joint, there may be two values for the bearing stress: $p_{fracture}$ and $p_{2\%}$.

a) What is the difference between these two values and when do you use which value?
b) If for a particular material $p_{fracture}$ = 800 MPa and $p_{2\%}$ = 600 MPa, which value should you use? Explain your answer.

Question 20

Composites may have different fibre lengths and have different polymers (thermoset or thermoplastic). Select for the following two combinations a feasible manufacturing process and briefly explain your choice.

a) Continuous fibres in bundles or rovings and a thermoset resin
b) Long (5-10 cm) carbon fibres and a thermoplastic matrix.

Success