Exam Production of Aerospace Systems

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

Date: Tuesday April 18, 2017, 9.00-12.00; TNW

20 Multiple Choice questions and 3 Open questions

Read carefully - write in clear script – give concise answers – In case of doubt give a brief explanation of your interpretation - Text of the reader & slides is leading

Multiple Choice Questions

(1 alternative per question – 3 points per MC question

Question 1

What is the most important feature of an assembly jig?

a. It's size (dimensions)
b. The required floor area
c. It's stiffness
d. It's price

Question 2

What is the best definition for the entity "waste" as used in Lean Manufacturing?

a. Waste are all those materials, scrap and leftovers that have to be removed after production
b. Waste are all those activities that support the production but does not add anything to the product.
c. Waste are all those activities that do not contribute to the value of the product
d. Waste are all those activities that are not favoured by the shareholders of the company

Question 3

What is meant with the "learning curve"? (one answer)

a. The curve that shows the decrease in man hours per aircraft with increasing serial number
b. The curve that shows the level of skills of the work force as function of time
c. The curve that shows the routine of an individual worker as function of time
d. The curve that shows the amount of training of the work force over time

Question 4

What statement about impregnation is false?

a. Impregnation is the mixing of the fibres and the resin
b. In a prepreg the fibres and resin are already mixed in the proper ratio
c. Impregnation can be performed before and after shaping of the fibre architectures
d. The polymer used for impregnation should have a high viscosity

Question 5

What statement about processing Fibre Reinforced Thermo-Plastics (FRTP) is false?

a. With adequate heat laminates of FRTP can be press formed like metal sheets
b. Resin injection processes cannot be applied to FRTP due to its high viscosity
c. Filament winding of FRTP is possible when the yarns include the polymer
d. For the hand lay-up of FRTP the prepregs have to be cut using thermal knives.

Question 6

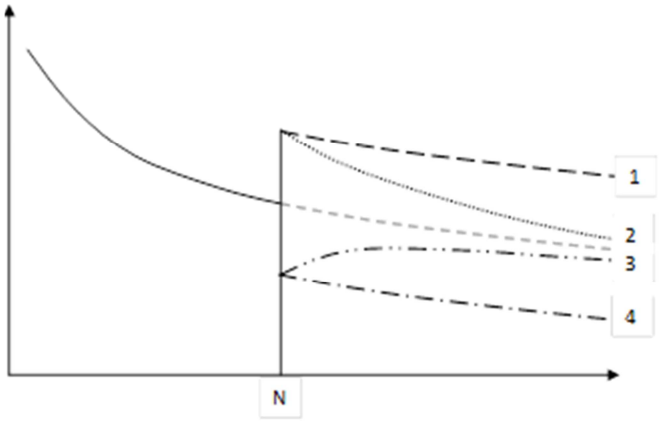
A heat treatment may have the following impact on a metal alloy:

a. The yield stress is increased and the ductility is reduced
b. The ductility is increased and the formability is increased
c. The sheet shows warpage (distortions) and becomes more brittle
d. The yield stress is reduced and the stiffness is increased.

Which one of these alternatives is false?

Question 7
What is a casting allowance? (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 8
When a modification is implemented in the assembly of aircraft number N, the learning curve changes according to line (see figure):
a. Line 1
b. Line 2
c. Line 3
d. Line 4



Question 9
What statement about hole-to-hole assembly is not correct?
a. Hole-to-hole assembly for smaller parts is more difficult than for larger parts
b. Hole-to-hole assembly can also be referred to as “meccano”-type assembly
c. Large benefit of hole-to-hole assembly is the elimination of drilling chips (etc.) at the assembly site
d. One requirement to implement hole-to-hole assembly is the use of conditioned workshops

Question 10
The manufacture of a composite component consists of a number of activities. Which of them is not “value adding” according to the definitions of Lean Manufacturing?
a. Tape laying and cutting
b. Autoclave process
c. Trimming by machining
d. Quality control by Non-Destructive Testing (NDT)

Question 11
Milling is a chip removing or machining process. Other machining processes are: (which answer is correct):
a. Drilling, water jet cutting, friction stir welding
b. Water jet cutting, laser jet cutting, punching and pulltrusion
c. Grinding, shearing, stamping, chemical etching
d. None of the answers is correct.

Question 12
Why do we apply high temperatures in the forging process?
a. To obtain the correct microstructure
b. To reduce the forming force
c. To limit the formability of the material
d. To enable the manufacture of very large parts

Question 13
Resin Transfer Moulding (RTM), Vacuum Infusion (VI) and Vacuum Assisted Resin Transfer Moulding (VARTM) are infusion processes. Which of the following statements is false?
a. Both RTM and VARTM require a press or other closing mechanism to counteract pressure
b. For both VARTM and VI the vacuum is the driving force for the resin injection
c. The level of accuracy (obtainable tolerances) is not the same for VARTM and VI
d. The vacuum in VARTM is primarily applied to reduce the void content in the product

Question 14
Composite processes are divided in processes where the fibres dominate (FD) the steering/control of the process (FD) and the ones where the resin dominates (RD). What alternative is false?
a. FD: filament winding, pulltrusion and RD: compression moulding
b. FD: Tape laying, resin transfer moulding and RD: sheet moulding compound
c. FD: Fibre placement, press forming and RD: injection moulding
d. One of the previous answers (a, b or c) is not correct

Question 15
What statement about the rule of mixtures is true:
a. The rule of mixtures should be used for the correct composition of thermoset resins
b. The rule of mixtures can be used to estimate some mechanical properties of composites
c. The rule of mixtures is a calculation method based on thickness ratios
d. The rule of mixtures is a general calculation method for composite properties

Question 16
Mention three failure modes of a riveted joint in a metal structure (one answer is true):
a. Net section failure, bearing failure, delamination
b. Rivet shear out, peel failure, rivet shear
c. Shrinkage cracking, rivet shear, net section failure
d. Bearing failure, rivet shear out, rivet shear

Question 17
Which of the following statements about adhesive bonding is true?
a. Adhesive bonding for thick adherents requires thicker bond lines
b. For the design of a bonded joint you need to know the maximum shear stress of the adhesive
c. The bath-tub-shape is created by the flexibility of the adhesive
d. Adhesive bonding for final assembly is no option because of the required small tolerances

Question 18
What is the structural breakdown of an aircraft?
a. The sectioning during recycling of the aircraft at the end of its life
b. The virtual sectioning of the aircraft for assembly purposes
c. The collapse of an aircraft during an accident
d. The real sectioning of the aircraft during maintenance

Question 19
What costs are included in the calculation of the Break Even Point? Select the best answer.
a. All costs for the investment in buildings and equipment
b. All costs directly related to the manufacture of the aircraft
c. All costs related to the aircraft program.
d. All costs for the financing of the project, including interest

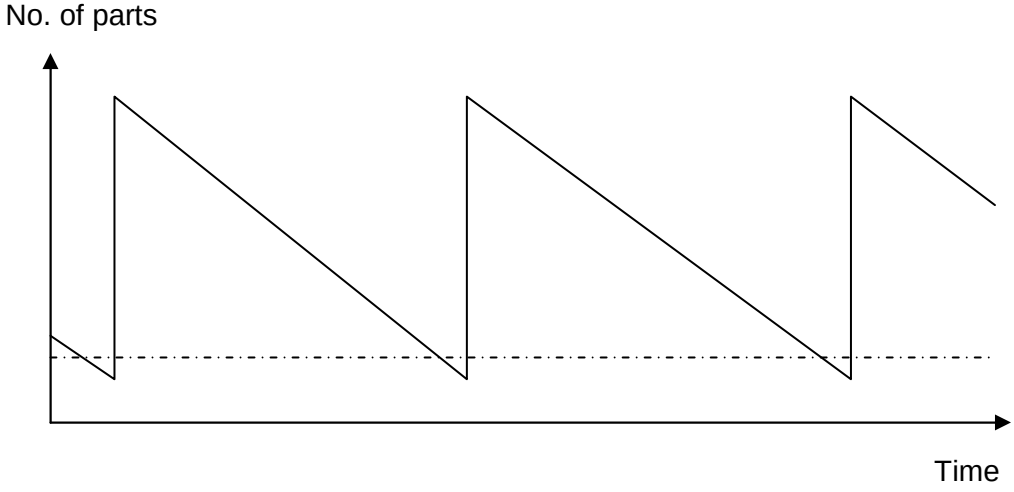
Question 20
5S (= Sort – Set in order – Shine – Standardize – Sustain) is tool in the inventory of Lean Manufacturing. What statement about this tool is true?
a. 5S is primarily aiming at reducing waste, not at increasing value
b. 5S is a typical tool that can be used on the shop floor only
c. 5S and 6 Sigma represent the same tool in Lean Manufacturing
d. 5S is aiming at reducing the cycle time in a production line.

Open Questions

(4 points each sub-question)

Question 21 - Bending
During bending the cross section is loaded beyond its yield limit.
a) Make sketches of the stress distribution and the strain distribution over the thickness.
b) In the cross section during bending you will have a so-called “neutral axis”. What is a neutral axis?
c) During air (or V-die) bending the radius is not constant in the bend zone. Explain this.
d) During roll bending the radius is more or less constant in the bend zone. Explain this.

Question 22 - Batches
a) Give a brief description of a “Batch”.
b) The figure below presents the number of parts in stock as function of time. Give a brief description of the features in this plot (peaks, slope, dotted line).
c) What is the explanation for the fact that the lower peaks are below the dotted line?



Question 23 - Assembly of aircraft.
a) Mention four different reasons why an aircraft has to be assembled.
b) The structural breakdown of an aircraft results in manufacturing and mounting divisions. Mention at least 2 structural features which are ideal to create a manufacturing or mounting division.
c) “Assembly adds weight to an aircraft”. Which features (2) in the joint contribute to the weight increase?

SUCCESS!!