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COURSE NAME:
(AEROSPACE MATERIALS)

Assignment Title:
(Assignment on Aerospace Materials)

ATLANTIC INTERNATIONAL UNIVERSITY
February/2022

Introduction

The structural materials used in airframe and propulsion systems influence the cost, performance and safety of aircraft, and an understanding of the wide range of materials used and the issues surrounding them is essential for the study of aerospace engineering. Aerospace materials reviews the main structural and engine materials used in aircraft, helicopters and spacecraft in terms of their production, properties, performance and applications.

It introduces the range of aerospace materials, focusing on recent developments and requirements. Further moves on to discuss the properties and production of metals for aerospace structures, strengthening of metal alloys, mechanical testing, and casting, processing and machining of aerospace metals. Next, it looked in depth at individual metals including aluminium, titanium, magnesium, steel and super alloys, as well as the properties and processing of polymers, composites and wood.

Multiple choice questions

1. The property of being liquefied due to heat is known as _____

a) stress

b) contraction

c) normalizing

d) fusibility

Answer: D

2. Hardness is inversely proportional to strength.

a) True

b) False

Answer: B

3. Which of the following property of a material is preferred in the construction of an aircraft?

a) Ductility

b) Elasticity

c) Hardness

d) High density

Answer: D

4. What is the temperature at which steel fuses?

a) 1100°F

b) 200K

c) 2500°F

d) 3500°F

Answer: C

5. Why do metals contract and expand?

a) Due to cooling and heating

b) Due to displacement

c) Due to repairs

d) Due to false recognition

Answer: A

6. A material elongated to 35m due to certain conditions. If it's initial length is 7m, what is the strain of the material?

a) 21m

b) 5m

c) 7m

d) 35m

Answer: B

Materials Selection – Properties of Flight Vehicle Materials

1. Materials with _____ are typically used in aircraft construction.

a) no strain

b) lower strength/weight ratio

c) average strength/weight ratio

d) higher strength/weight ratio

Answer: D

2. Which of the following is not a property of aluminium that makes it ideal to use as an aircraft material?

a) Resistance to corrosion

b) Light in weight

c) High fuel consumption

d) High strength alloy

Answer: C

3. Using materials with good joining properties is an advantage.

a) True

b) False

Answer: A

4. Why is the reliability of a material an important property?

a) To maintain material cost

b) To maintain the quality of material

c) To obtain old stock material

d) To consider supplementary material

Answer: B

5. Which of the following is an economic consideration of a material?

a) Structure

b) Appearance

c) Availability

d) Strain

Answer: C

6. Porosity is the quantity of void space in a structure.

a) True

b) False

Answer: A

7. What is the fuselage of an aircraft made of?

a) Pure iron

b) Acrylic

c) Aluminium alloy

d) Magnesium

Answer: C

8. Which of the following materials is used in making aircraft windows?

a) Thick glass

b) Plexiglass

c) Graphite

d) Plane glass

Answer: B

9. Magnesium and its alloys are suitable to use in the construction of helicopters.

a) True

b) False

Answer: A

10. Which of the following can be used as wing covering in an aircraft?

a) Manganese alloy

b) Carbon

c) Titanium

d) Aluminium alloy

Answer: D

11. Controls can be made using _____

a) wood

b) copper

c) steel

d) flaps

Answer: C

12. Which of the following can be used to make seats in an aircraft?

a) Magnesium alloy sheets

b) Graphite

c) Rubber

d) Pure magnesium

Answer: A

13. Metals like chrome-molybdenum steel are heated to a temperature of _____ to make bushings.

a) 500 or 750 psi

b) 1000 psi

c) 650,000 or 7000,000 psi

d) 125,000 or 150,000 psi

Answer: D

14. Wood cannot be used to make any part of an aircraft.

a) True

b) False

Answer: B

15. Bolts in an aircraft are made of _____

a) nickel steel

b) graphite

c) aluminium

d) iron

Answer: A

16. Which of the following is not used to manufacture a wing-tip bow?

a) Chrome-molybdenum

b) Aluminium alloy

c) Douglas fir

d) Mild steel

Answer: C

17. What are the wheels of a landing great made of?

a) Typical rubber

b) Sensitive rubber

c) Titanium alloy

d) Thick rubber

Answer: D

18. Which of the following specification is used in manufacturing fuselage, oil tank and wings of an aircraft?

a) 1111-Z

b) 2024-T4

c) 2011-X2

d) 1214-A

Answer: B

19. Which of the following components is/are used in making aircraft wings?

a) Titanium alloys

b) Graphite

c) Aluminium alloys

d) Titanium alloys and aluminium alloys

Answer: A

20. Non-metallic materials are primarily used in manufacturing _____

a) fuselage

b) engine

c) wing tips and stabilizer tips

d) seats

Answer: C

Testing Aircraft Materials – Inspection Methods

1. Which of the following are standard inspection methods of aircraft materials?

a) Radiography and fatigue test

b) Magnaflux and bending inspection

c) Radiography and magnaflux inspection

d) Fatigue and bending inspection

Answer: C

2. Which of the following is a non-destructive way of inspecting materials?

a) Fatigue

b) Radiography

c) Welding

d) Bending

Answer: B

3. When radiographs are produced to detect defects, they show up as _____

a) tubes

b) dark spots

c) invisible spots

d) light spots

Answer: D

5. X-rays can be used to inspect materials of steel up to a thickness of _____ inches.

a) 3

b) 15

c) 0.3

d) 26

Answer: C

6. Which of the following can the inspection process ‘magnaflu’ not detect?

a) Laps

b) Cracks

c) Seams

d) Color

Answer: D

7. In which direction should the magnetic flux be induced on the specimen?

a) Upper

b) Lower

c) All directions

d) North

Answer: C

8. Which of the following is a way to magnetize a specimen?

a) Angular magnetization

b) Momentum magnetization

c) Circular magnetization

d) Zero magnetization

Answer: C

9. Not only the presence of defects, but their location can also be known in the magnaflux inspection process.

a) True

b) False

Answer: A

10. _____ can be put on the specimen in the form of magnetic powder.

a) Uranium

b) Black iron oxide

c) Charred wood

d) Chromium

Answer: B

Applications and Advantages of Aluminium

1. _____ percent of earth's crust is aluminium.

a) 3%

b) 25%

c) 60%

d) 7%

Answer: D

2. Aluminium is _____ and _____

a) non-hygienic, toxic

b) toxic, hygienic

c) non-toxic, hygienic

d) non-hygienic, non-toxic

Answer: C

3. Aluminum has _____ strength to weight ratio.

a) moderate

b) low

c) high

d) infinite

Answer: C

4. The metal aluminium can be _____ to obtain strength.

a) heat-treated

b) nullified

c) softened

d) non-heat treated

Answer: A

5. In the aircraft industry, aluminium is _____ used.

a) moderately

b) widely

c) not often

d) hardly

Answer: B

Properties and Advantages of Titanium and its Alloys

1. Titanium alloys can be forged _____

a) moderately

b) with great difficulty

c) unnecessarily

d) easily

Answer: D

2. Titanium has applications in the _____ industries.

a) aerospace

b) chemical

c) aerospace and chemical

d) chemical and stock

Answer: C

3. Titanium alloys (body centred cubic) _____ heat treatment for high strength.

a) require

b) are made by

c) do not require

d) preceded

Answer: C

4. Titanium can be used in the medical industry.

a) True

b) False

Answer: A

5. Titanium alloys (body-centred cubic) have very low density.

a) True

b) False

Answer: B

Advantages and Applications of Steel

1. _____ is a special kind of steel that is used exclusively for nitride components.

a) Nitric

b) Hy-Tuf

c) Austenitic

d) Nitriding steel

Answer: D

2. _____ is the name that refers to steel used in high tensile strength. (220,000-240,000 p.s.i)

a) S.A.E 1103

b) Carburizing

c) Hy-Tuf

d) S.A.E 8375

Answer: C

3. _____ is known as Hadfield's manganese steel.

a) 6150 steel

b) Hydroxide steel

c) Austenitic manganese steel

d) Nitride manganese steel

Answer: C

4. S.A.E 4037 is a _____ steel that can be used as a substitute for nickel steel in making bolts, pins etc.

a) hydroxide

b) vanadium

c) molybdenum

d) chromium

Answer: C

5. It is extremely difficult to fabricate steel.

a) True

b) False

Answer: B

Applications and Properties of Magnesium and its alloys

1. Magnesium alloys can be made into _____ sophisticated structures compared to aluminium alloys.

a) Zero

b) Less

c) Similar

d) more

Answer: D

2. Which of the following components of aircraft can be manufactured using magnesium?

a) Engine

b) Wheels

c) Engine, landing gear

d) Landing gear

Answer: C

3. Magnesium _____ fuel efficiency.

a) Maintains

b) Reduces

c) Improves

d) Does not affect

Answer: C

4. Magnesium powder can be used for photographic applications.

a) True

b) False

Answer: A

5. Magnesium is the most abundant element found in the earth's crust.

a) True

b) False

Answer: B

Properties of Copper and its Alloys

1. Muntz metal consists of _____ copper and _____ zinc.

a) 75%, 25%

b) 25%, 75%

c) 50%, 50%

d) 60%, 40%

Answer: D

2. Manganese bronze is remarkably _____

a) difficult to forge

b) weak

c) strong

d) low in zinc

Answer: C

3. _____ is also known as Tobin bronze.

a) Red clay

b) Sand

c) Uranium

d) Naval brass

Answer: D

4. Red brass (casting) has a UTS of _____

a) 15,00 pound-force per square inch

b) 29 pound-force per square inch

c) 30,000 pound-force per square inch

d) 10000 pound-force per square inch

Answer: C

5. Phosphor bronze can be utilized in the manufacturing of _____

a) skids

b) tires

c) rubber wheels

d) bolts

Answer: D

Applications and Advantages of Nickel

1. Inconel is accessible commercially in which of the following shapes?

a) Tube

b) Wires

c) Z-shapes

d) Tubes and wires

Answer: D

2. Monel is used in making _____

a) oil coolers

b) rivets

c) oil coolers and rivets

d) rubber tires

Answer: C

3. _____ metal is used near compasses.

a) Monel

b) Inconel

c) K Monel

d) Iron

Answer: C

4. Nickel is suitable for manufacturing in mobile phones and power generators.

a) True

b) False

Answer: A

5. Inconel weighs _____ corrosion-resistant steel.

a) less than

b) more than

c) equal to

d) double of

Answer: B

Aircraft Steels – Zinc and its Alloys

1. The atomic number of zinc is _____

a) 25

b) 13

c) 104

d) 30

Answer: D

2. The density of Zinc is _____ at room temperature.

a) 2.7 gram per cubic centimetre

b) 6.52 gram per cubic centimetre

c) 7.14 gram per cubic centimetre

d) 0.44 gram per cubic centimetre

Answer: C

3. Zinc in the form of ores can be found in which of the following places?

a) Antarctica

b) Canada

c) Canada and Russia

d) Russia and Antarctica

Answer: C

4. Zinc is a non-lustrous element.

a) True

b) False

Answer: B

5. Zinc is alloyed with which of the following elements frequently?

a) Vanadium

b) Copper

c) Helium

d) Rutherfordium

Answer: B

Conclusion

We looked at the fundamentals for the analysis of materials and structures in engineering with a specific focus on aircraft and space structures. The lectures were splitted into two

parallel modules: Solid Mechanics and Materials and Structures. The Solid Mechanics module covers general material relating to the analysis of stresses, strains, deformation, and strength in solid materials and simple components. Specific topics included stress and strain tensors, elasticity, plasticity, elementary solutions of theories of elasticity and plasticity, principles of minimum potential energy, and finite element modeling. The second module, Materials and Structures is focused on the application of material and structural design to aerospace components and structures. Topics covered included composite materials and mechanics, unsymmetrical sections, and analysis of skinned structures.

Bibliography

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