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Question Paper Code : 91072

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019
Sixth Semester
Aeronautical Engineering
AE6604 – AIRCRAFT MATERIALS AND PROCESSES
(Regulations 2013)

Time : Three Hours

Maximum : 100 Marks

Answer ALL questions

PART – A

(10×2=20 Marks)

1. Mention the three basic groups of solid materials.
2. What is a unit cell ?
3. Differentiate between yielding and fracture.
4. Define the modulus of resilience.
5. How does brittle fracture take place – what are its characteristics ?
6. What are the drawbacks of magnesium for aerospace applications ?
7. Name the two most common methods of alloying.
8. Super-elasticity is the ability of a material to _____
9. Give reason for the limited and restricted use of metal matrix composites.
10. How does high temperature affect creep ?

PART – B

(5×13=65 Marks)

11. a) How is unit cell geometry defined ? Neatly sketch the 7 different types of crystal systems and express the lattice parameter relationship for each.

(OR)

- b) i) Define coordination number, atomic packing factor and linear density in the atomic structure of materials. (3)

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- ii) Compare the number of atoms per unit cell, coordination number, atomic packing factor and cube edge length for the 3 principal crystal structures found in most metals. (10)

12. a) Based on the tensile stress-strain behaviour curve for the brass specimen shown in Figure 1, determine the following parameters-the strain axis has been expanded in the inset of the figure to facilitate computation.

- i) modulus of elasticity and yield strength (based on strain offset of 0.002). (7)
- ii) maximum load that can be sustained by a cylindrical specimen of the same material having an original diameter of 12.8 mm. (3)
- iii) Change in length of a specimen originally 250 mm long and subject to a tensile stress of 345 MPa. (3)

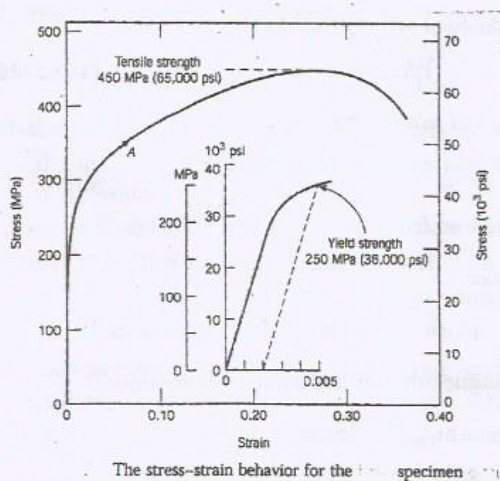


Figure 1

(OR)

b) Explain the phenomenon of material fatigue. What are the common variables used for fatigue prediction ?

13. a) Discuss the following types of corrosion :
- i) hydrogen embrittlement (4)
 - ii) stress corrosion and (5)
 - iii) intergranular corrosion. (4)

(OR)

- b) i) Discuss the features and characteristics of hot working and cold working of metals. (6)
- ii) Give brief descriptions of a few common metal forming operations. (7)



14. a) What do Metal Matrix Composites (MMCs) usually consist of? What are the current disadvantages of MMC's? Write about the current application of MMC's. Name 2 metal matrix composites and state their properties.

(OR)

- b) i) List the desirable characteristics, features and advantages of carbon-carbon composites as a high temperature material for aerospace application. (7)
ii) How are carbon-carbon composite parts fabricated? (6)
15. a) i) What is a super-alloy? What are the good properties of super alloys? (7)
ii) Give reasons for the variation found in experimental material characterization data. What are the effects of high temperature on the properties of composites used in aircraft? (6)

(OR)

- b) i) List the design requirements on the materials of a thermal protection system of a space vehicle. (6)
ii) Give examples of candidate material systems (give the material composition) of the thermal protection system of a space vehicle stating their operating temperatures and the location on the space vehicle where the material system is employed. (7)

PART – C

(1×15=15 Marks)

16. a) Choose the correct option for each of the following questions (each question 1½ mark.)

- (1) In Grey cast iron, carbon is present as
i) Graphite flakes ii) Graphite modules
iii) Cementite iv) Carbon does not exist
- (2) Seasonal cracking is observed in
i) Stainless Steel ii) Brass
iii) Cast iron iv) Inconel
- (3) Which among the following is not the effect of increasing carbon content in steel?
i) Increase in hardness and strength
ii) Decrease in weldability
iii) Increase in ductility
iv) Decreased machinability
- (4) Weibull modulus is used to predict
i) Hardness of ceramics
ii) Creep strength of ceramics
iii) Probability of failure
iv) Fracture toughness

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- (5) Important general properties of ceramic do not include
- Strong in compression
 - Chemically inert
 - Inorganic crystalline materials
 - High fracture toughness
- (6) The correct sequence of elements of 18/8 Stainless Steel is
- 18% Chromium and 8% Nickel
 - 18% Nickel and 8% Chromium
 - 18% Vanadium and 8% Chromium
 - 18% Chromium and 8% Vanadium
- (7) Which of the following metals has BCC crystal structure ?
- Copper
 - Gold
 - Chromium
 - Silver
- (8) Which of the following statement is true ?
- Ionic bond predominates between elements of low electro-negativity difference.
 - BCC and HCP metals undergo plastic deformation only by twinning.
 - Covalent bonds are non-directional in nature.
 - Schottky defect is found in ionic compounds with high coordination number.
- (9) Poisson ratio value for aerospace ceramic materials typically lie in the range of
- 0.17 – 0.30
 - 0.30 – 0.35
 - 0.35 – 0.45
 - 0.32 – 0.42 but negative
- (10) Increasing grain size in a polycrystalline material
- Increases yield strength and corrosion resistance
 - Decreases yield strength and corrosion resistance
 - Decreases yield strength and increases corrosion resistance
 - Increases the yield strength and decreases corrosion resistance

(OR)

- b) i) Compare the properties of different metals, ceramics and composites that are used for aerospace application. (7)
- ii) Explain the current status of titanium/titanium alloys in aircraft engines. Give an example of a titanium alloy currently being employed in aircraft. (8)