

**II B.Tech. II Semester Regular Examinations, April/May -2005**  
**AEROSPACE MATERIALS**  
**(Aeronautical Engineering)**

**Time: 3 hours**

**Max Marks: 80**

**Answer any FIVE Questions**  
**All Questions carry equal marks**

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1. (a) Why does a dislocation of larger Burger's vector try to break it self into smaller dislocations.  
(b) A positive dislocation of 1mm length climbs down by 1  $\mu\text{m}$  in a single cubic crystal of lattice constant  $3^0 \text{ \AA}$ . Find whether vacancies are created or lost and by how much.
2. (a) Describe the conditions under which strain hardening will occur in Mild steel. Why does not strain hardening occur in cast Iron.  
(b) Explain the behavior of a material under the following conditions.
  - i. Repeated loading and unloading in tension.
  - ii. Repeated loading and unloading in compression.
  - iii. Repeated loading and unloading in alternate tension & compression.
3. (a) Compare the annealing and normalizing of plain carbon steels. Explaining the differences in thermal cycles given when the composition of steel increases from Hypo to Hyper Eutectoid.  
(b) Aluminium and Magnesium form 2 useful commercial alloy systems i.e. Al-Mg and Mg-Al alloys. Discuss the reasons for the development of these alloy systems.
4. (a) What do you understand by the term corrosion? Explain the mechanism of corrosion in detail.  
(b) Explain why does corrosion generally occur at the anode.  
(c) Explain the mechanism of Electrochemical corrosion.
5. (a) What are wrought Aluminium alloys? How is the temper of wrought alloys determined?  
(b) Explain precipitation hardening in Aluminium-copper 4.3% alloy?
6. (a) Give the classification of polymers? Explain the basis on which such a classification is made.  
(b) What are amorphous plastics? Give examples of atleast four plastics.
7. Explain the following composites.
  - (a) Metal matrix composites.
  - (b) Dispersion strengthened alloys.

8. How are the nickel based super alloy structural components manufactured? Describe hot isostatic pressing of nickel based alloy powders.

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1. (a) Define a crystalline solid. What are the three most common crystal structures. List five metals which have each of these crystal structures.  
(b) Derive the relationship between the length of the side 'a' of the BCC unit cell and the radius 'r' of the atom.  
(c) Tungsten is BCC and has an atomic radius of 0.141 nm. Calculate the lattice constant in Angstrom units.  
(d) Calculate the effective number of atoms for FCC unit cell.
2. (a) What are the specific advantages and limitations of X-ray & Y-ray radiography.  
(b) Explain effect of notch on stress concentration.  
(c) Explain the principle and working of Magnetic particle flaw detection method.
3. (a) Hardened steel always requires tempering. Explain.  
(b) Explain heat treatment, properties and applications of Ti-6Al-4V alloy? Explain the difficulties involved in vacuum heat treatment.
4. (a) Explain the effect of PH value on corrosion.  
(b) Compare oxygen absorption and hydrogen evolution mechanisms in corrosion cell.  
(c) What do you understand by cathodic protection? Explain with examples the working of sacrificial anode.
5. (a) Give the classification of Aluminium alloys. On what basis such a classification is made?  
(b) What are the castable type of aluminium alloys you know? Give the composition and industrial uses of 4 aluminium alloys?
6. (a) What are the elastomers? Explain.  
(b) What are the various synthetic rubbers you know? Explain? Give industrial applications of these.
7. (a) What are the components, made by Titanium alloys, used in aircrafts. Give reasons of its usage.  
(b) What is the material which is normally used for tyres of aircraft? How this is produced?

8. How are the nickel based super alloy structural components manufactured? Describe hot isostatic pressing of nickel based alloy powders.

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(c) Tungsten is BCC and has an atomic radius of 0.141 nm. Calculate the lattice constant in Angstrom units.  
(d) Calculate the effective number of atoms for FCC unit cell.
2. (a) What is strain hardening? What is the mechanism of strain hardening? Explain this with the help of stress-strain curve.  
(b) A force of 20000 N will cause a 10 mm X 10 mm bar of Magnesium to stretch from 100 mm to 100.45 mm. Calculate the modulus of Elasticity.
3. (a) Compare and contrast the following terms:
  - i. Martensite and Tempered Martensite
  - ii. Austenite and tempered Martensite.  
(b) An aircraft manufacturer receives a shipment of aluminium alloy rivets that are already age hardened. Can they be salvaged? Explain your answer.
4. Explain the effects of the following on corrosion rate.
  - (a) solution concentration
  - (b) Velocity.
  - (c) Temperature
  - (d) Galvanic coupling.
5. (a) Give the classification of Aluminium alloys. On what basis such a classification is made?  
(b) What are the castable type of aluminium alloys you know? Give the composition and industrial uses of 4 aluminium alloys?
6. (a) What is co-polymerization? With the aid of an example explain it?  
(b) Solve:  
How many gms of sulphur are required for 100gms of final rubber product to completely cross link butadiene rubber with 1 sulphur atom per connection:

7. Explain the following composites.
  - (a) Metal matrix composites.
  - (b) Dispersion strengthened alloys.
8. (a) Name some of the super alloys which are used in aircraft industry? Give their nominal compositions.
  - (b) Give the microstructure, composition of Nickel base and cobalt base heat resistant casting alloys.

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1. Differentiate between the following
  - (a) Climb up & climb down
  - (b) Cross slip & Jog
  - (c) Partial dislocations & mixed dislocations.
2.
  - (a) Discuss with the help of a neat sketch the mechanism of Bauschinger's effect.
  - (b) Enumerate the steps that lead to ductile fracture of a metal. Explain why does steel fracture with a cup & cone shape.
3. Explain the following:
  - (a) Stages in tempering process
  - (b) Secondary hardening
  - (c) Harden ability
  - (d) Athermal process.
4.
  - (a) What are the typical changes in the medium that are often employed for reducing corrosion? Explain them.
  - (b) Explain the similarities and differences between the table of standard electrode potentials and the table of galvanic series.
5.
  - (a) How Aluminium alloys are welded? What are the difficulties that have encountered in welding heat treatable aluminium alloys.
  - (b) Give the composition of any two high temperature resistance Aluminium alloys. What are their applications?
6.
  - (a) Give the classification of polymers? Explain the basis on which such a classification is made.
  - (b) What are amorphous plastics? Give examples of atleast four plastics.
7.
  - (a) What are the components, made by Titanium alloys, used in aircrafts. Give reasons of its usage.
  - (b) What is the material which is normally used for tyres of aircraft? How this is produced?
8. What are the castable type of super alloys that are used in air space industry? Name a few components indicating their composition.

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