

JUN 11 2018

KATHMANDU UNIVERSITY  
End Semester Examination [C]  
June, 2018

Marks Scored:

Level : B.E.

Year : II

Exam Roll No.:

Time: 30 mins.

Course : MEEG 213

Semester : I

F.M. : 10

Registration No.:

Date :

SECTION A

[20 Q. × 0.5 = 10 marks]

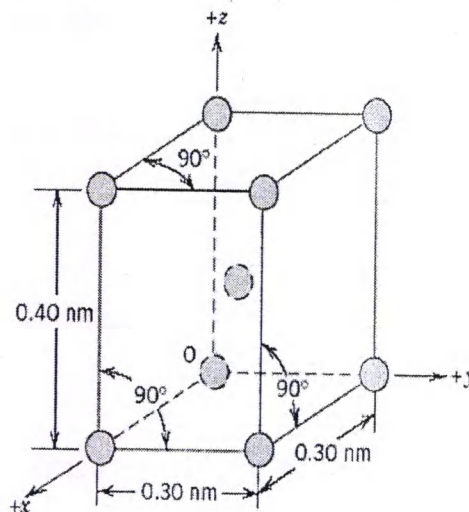
Cross [ × ] mark the most appropriate answer.

1. Chemical make up of a material refers to  
(a) composition      (b) structure      (c) both a and b      (d) synthesis
2. Crystal structure is  
(a) lattice only      (b) Lattice + basis      (c) lattice + motif      (d) both b and c
3. Temporary deformation is  
(a) elastic      (b) plastic      (c) fracture      (d) both a and b
4. Atoms can have \_\_\_\_\_ motion.  
(a) oscillatory      (b) rotational      (c) translational      (d) all of them
5. Polycrystalline materials have  
(a) many crystals      (b) many grains      (c) both a and b      (d) none of them
6. Blister copper is an impure copper.  
(a) True      (b) False
7. Grain boundary where mirror lattice symmetry is present is  
(a) twin      (b) twist      (c) tilt      (d) all of them
8. Pores are  
(a) volume defects      (b) point defects      (c) line defects      (d) none
9. Hall Petch equation is given by  $\sigma_y = \sigma_0 + Kd^{-\frac{1}{2}}$  where  $\sigma_y$  refers to yield strength and  $d$  refers to average diameter while  $\sigma_0$  and  $K$  are constants. The yield strength of mild steel with an average grain size of 0.05 mm is 20,000 psi. The yield stress of the same steel with a grain size of 0.007 mm is 40,000 psi. In what range average grain size ( $d$ ) of the same steel with a yield stress of 30,000 psi lie ? (1000 psi = 6.985 MPa)  
(a)  $0.007 < d < 0.05$       (b)  $0.007 > d > 0.05$   
(c)  $d > 0.05$       (d)  $d < 0.007$
10. Minimum stress required to move dislocation is  
(a) peierls nabarro (PN)      (b) lattice friction  
(c) peierls stress      (d) all of them

11. ASTM defines the grain size number as  $N = 2^{G-1}$  where  $N$  is the average number of grains per square inch at a magnification of 100 X and  $G$  is the grain size number. Determine the ASTM grain size number of a metal specimen if 45 grains per square inch are measured at a magnification of 100 X.  
 (a) 6.5 (b) 7.5 (c) 8.5 (d) none of them
12. Coordination number for simple cubic crystal structure is  
 (a) 6 (b) 8 (c) 10 (d) 12
13. Void fraction for which of the following system is 0.26 ?  
 (a) FCC (b) HCP (c) BCC (d) both a and b
14. A 10 mm diameter Brinell hardness indenter produced an indentation 1.62 mm in diameter in a steel alloy when a load of 500 kg was used. Compute the HB of this material if HB is given as

$$HB = \frac{2F}{\pi D [D - \sqrt{D^2 - d^2}]}$$

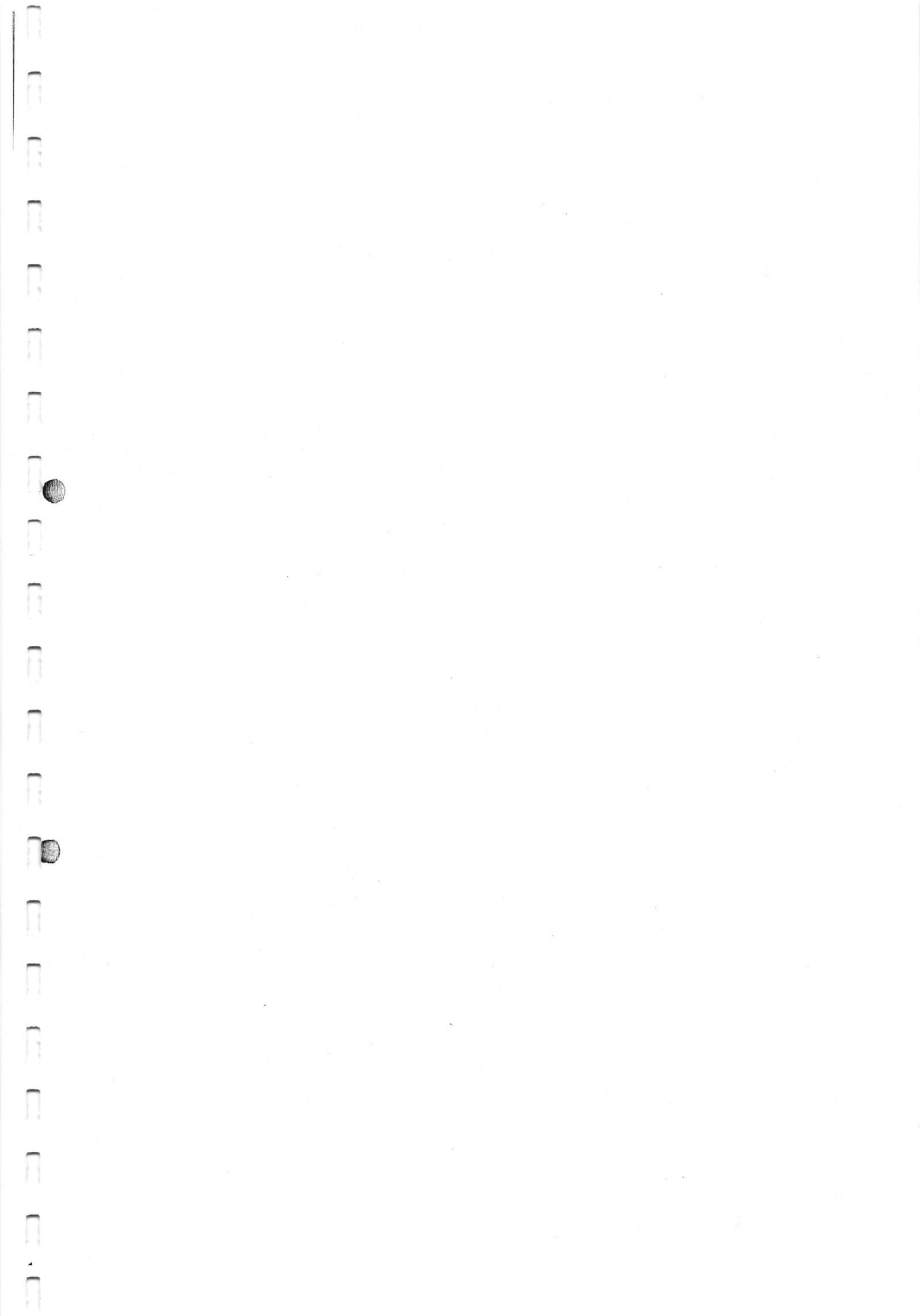
- (a) 240 (b) 241 (c) 242 (d) 243
15. To which crystal system does this unit cell belong?



- (a) simple cubic (b) Hexagonal  
 (c) Tetragonal (d) Rhombohedral
16. Transformation of austenite to which of the following is not an isothermal transformation?  
 (a) martensite (b) pearlite (c) bainite (d) coarse pearlite
17. Ceramics are  
 (a) oxides (b) carbides (c) nitrides (d) all of the above

JUN 11 2018

18. Metastable stable state refers to  
(a) local energy minimum (b) global energy minimum  
(c) maximum energy state (d) none of these
19. The metal iridium has an FCC crystal structure. If the angle of diffraction for the (220) set of planes occurs at  $69.22^\circ$  (first-order reflection) when monochromatic x-radiation having a wavelength of 0.1542 nm is used, compute the inter-planar spacing for this set of planes if Braggs equation is  $n\lambda = 2d \sin \theta$ .  
(a) 0.1357 nm (b) 0.08246 nm (c) 0.2345 nm (d) 0.10568 nm
20. Which of this is not a destructive testing method?  
(a) impact test (b) tensile test (c) hardness test (d) none of these



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Semester: I  
F.M. : 40

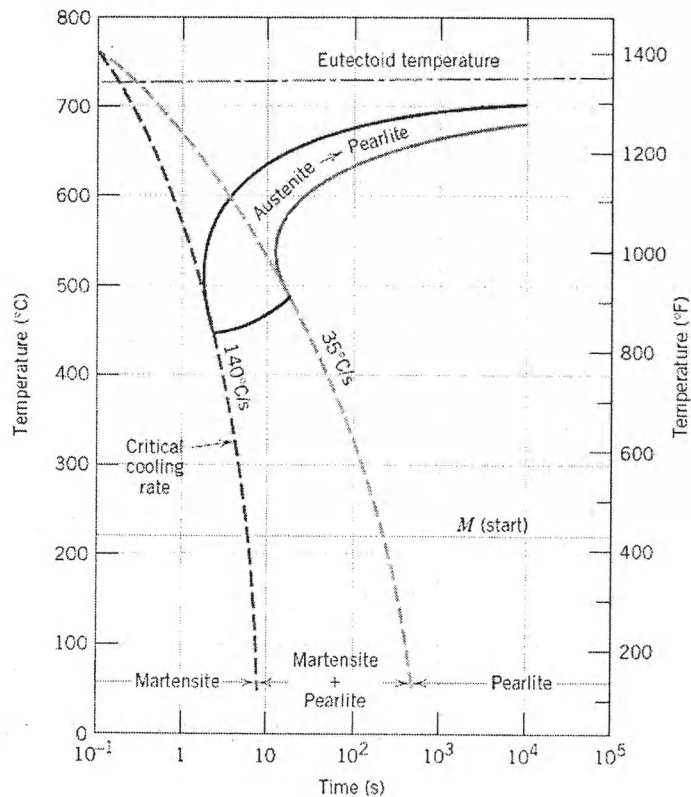
SECTION "B"

Q.N. 1

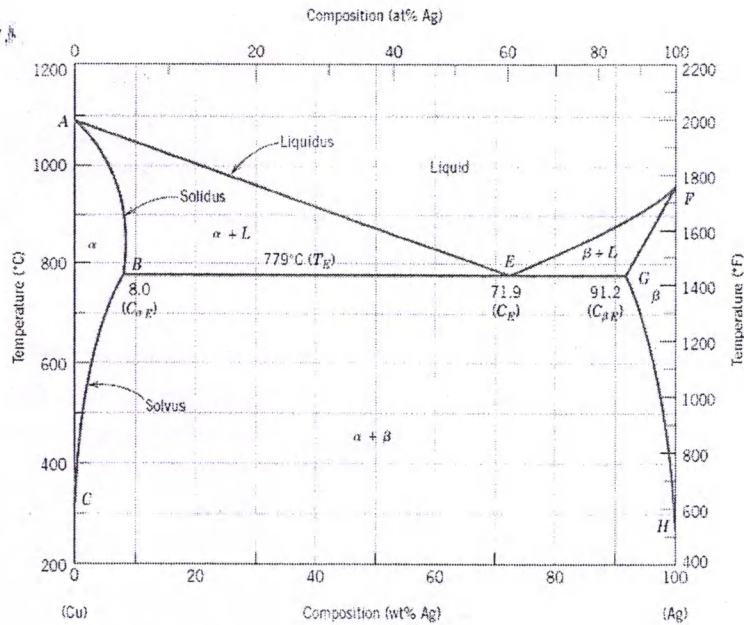
- a. Name the microstructural products of eutectoid iron-carbon alloy (0.76 wt % C) specimens that are first completely transformed to austenite, and then cooled to room temperature at the following rates for the continuous cooling diagram shown below.

[1+1+1]

- a) 200 °C/s,  
b) 100 °C/s, and  
c) 20 °C/s.



- b. Which transformation region is absent on the continuous cooling transformation diagram for an iron-carbon alloy of eutectoid composition? [1]



Q.N. 2

For a copper-silver alloy of composition 25 wt % Ag-75 wt % Cu and at 775 °C (1425 °F) do the following: [1+1+1+1]

- Write the complete Eutectic reaction for the alloys shown
- Determine the mass fractions of  $\alpha$  and  $\beta$  phases.
- Determine the mass fractions of primary  $\alpha$  and eutectic micro-constituents.
- Determine the mass fraction of eutectic  $\alpha$ .

Q.N. 3

- a. Define the following terms.

[0.5+0.5+0.5+0.5 = 2]

- Green Ceramics
- Sintering
- Vitrification
- Glass Temperature

- b. Describe the steps in slip casting of ceramics

[2]

Q.N. 4

- a. Write a principal difference between cast alloys and wrought alloys.

[1]

- b. Show in what aspect brass and bronze are different though brass and bronze are copper alloys.

[1]

- c. Suppose you were hired as a materials science engineer to design a wing of an aircraft. Describe in brief what steps you would follow before the wing could come into the final desired shape along with the type of a material and its alloy and different properties that you would take into account while selecting a material.

[2]

Q.N. 5

JUN 11 2018

The results of an x-ray diffraction experiment using x-rays with  $\lambda = 0.8659 \text{ \AA}$  (radiation obtained from a Nickel (Ni) target) show that diffracted peaks occur at the following  $2\theta$  angles. Determine the crystal structure, the indices of the plane producing each peak, and the lattice parameter of the material. (For FCC,  $h, k,$  and  $l$  must all be either odd or even and for BCC,  $h + k + l$  must be even)

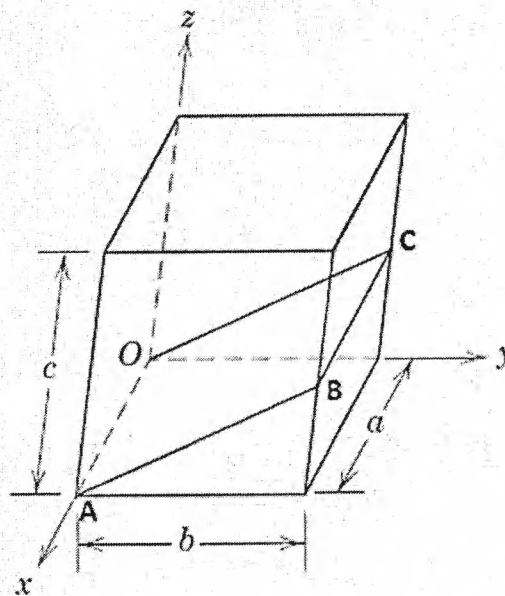
[4]

Peak	$2\theta$ (in degrees)
1	20.20
2	28.72
3	35.36
4	41.07
5	46.19
6	50.90
7	55.28
8	59.42

Q.N. 6

a. Show that the void fraction for BCC crystal structure is 0.32. [2]

b. Find the Miller indices for the plane OABC shown in the Figure below. [2]



Q.N. 7

a. Differentiate artificial aging and natural aging. Write the necessary conditions (only two) required for precipitation hardening. [2]

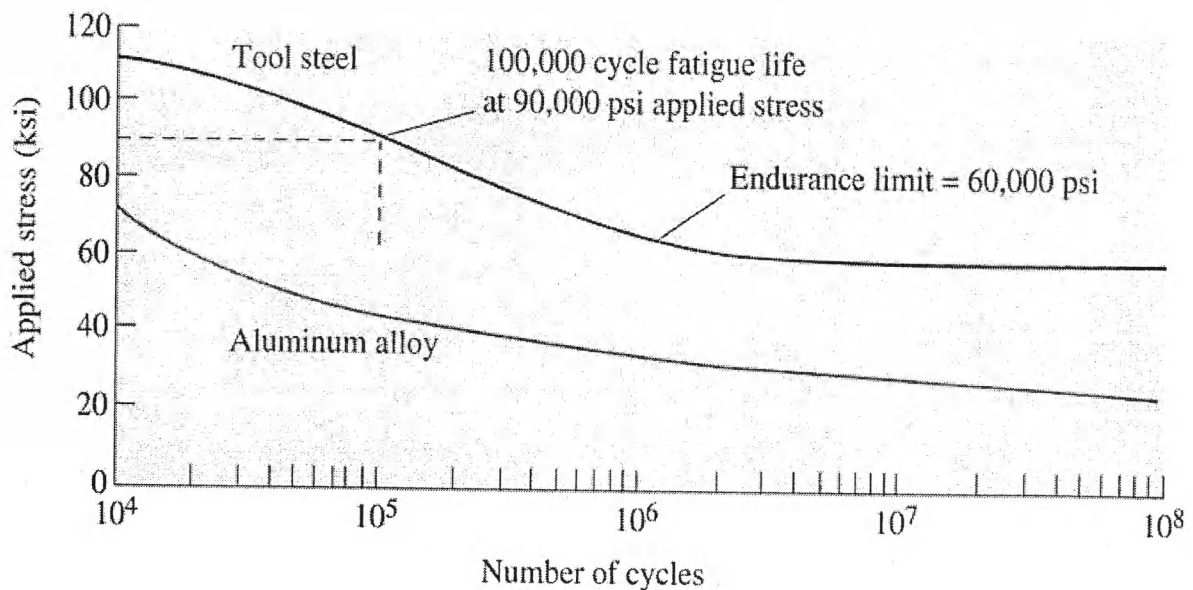
- b. In your own words describe the following heat treatment procedures for steels and, for each, the intended final microstructure: full annealing, normalizing, quenching, and tempering. [4]

Q.N. 8

- a. Cite the relation between Burgers vector and dislocation line orientations for edge, screw, and mixed dislocations. [2]
- b. Briefly explain the concept of first law of diffusion. What is the driving force for steady-state diffusion? [2]

Q.N. 9

- a. Describe the tensile test along with the graph. [2]
- b. The following curve shows the S-N curve. [2]
- (i) Name the test that would yield following curve.
- (ii) What would be the cycle fatigue life at applied stress of 80 ksi?



Q.N. 10

Investigate the origins and applications for a material that has been invented or discovered since long time. Write one paragraph about this material or product. [2]