U218-156 (T2)

OCTOBER 2018/ IN-SEM (T2)
S. Y. B. TECH. (MECHANICAL ENGINEERING) (SEMESTER - I)
COURSE NAME: MATERIAL SCIENCE AND ENGINEERING METALLURGY
COURSE CODE: MEUA21176
(PATTERN 2017)

[Max. Marks: **30**]

Marking Scheme

Q.1)
a) Define the following [6 marks]
i] Eutectic system ii] NA of objective iii] Equilibrium diagram
2 marks for each definition

b)) Draw the diagram of metallurgical microscope and label it? [6 marks]
And label it properly?
4 mark for diagram
2 for labeling

c) Write the rules of solid solution formation? [4 marks]
4 rules each one for 1 mark

OR

Q.2)
a) Define the following [6 marks]
i] Dark field illumination ii] Macro-reagent iii] polishing
2 marks for each definition

b)) Two metals are having 100% solubility in liquid state and 0% in solid state, draw the equilibrium diagram when the mixture is existing at 30%B at 415 temperature for reaction and 800 and 1000 are melting of A and B respectively? Label it properly? [6 marks]
4 marks for diagram 2 for labeling

c) What are the advantage of steel over cast iron? [4 marks]
1 mark for each advantage in detial

Q.3)
a) Define the following [6 marks]
i] Ledeburite ii] Austenite iii] Delta ferrite
2 marks for each

b) Write first two reaction with temperature on iron carbon system [4 marks]

from lower to higher?
Eutectoid and Eutectic only
Each reaction and temp 2 mark

c) what are advantages of steel over cast iron? [4 marks]
4 mark for writing min 4 advantages

OR

Q.4)
a) Define the following [6 marks]
i] Hyper-eutectoid steel ii] Allotropy iii] Pearlite
2 marks for each definition

b) Explain what is AISI 1020 and En 8 [4 marks]
2 marks each

c) Draw the Iron Carbon diagram and label it? [4 marks]
4 mark for drawing and labeling

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[Max. Marks: **30**]

Q.1) a) Define the following [6 marks]

i] Eutectic system : System is a part under consideration

It is system in which two elements are completely soluble in each other and immiscible in each in solid state

ii] NA of objective: It is the light gathering or light collecting ability of an objective. It is constant for a given objective and is a function of design.

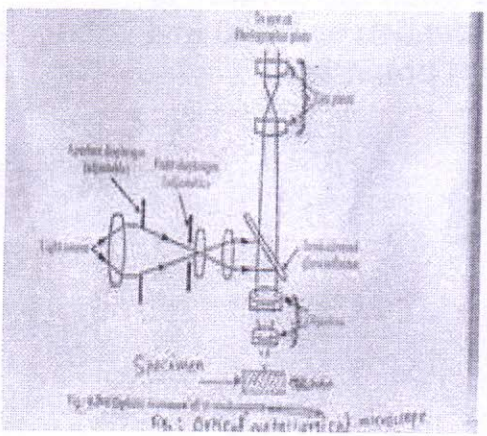
Numerical Aperture (NA)= $n \times \sin(\mu)$ or $n \times \sin(\alpha)$

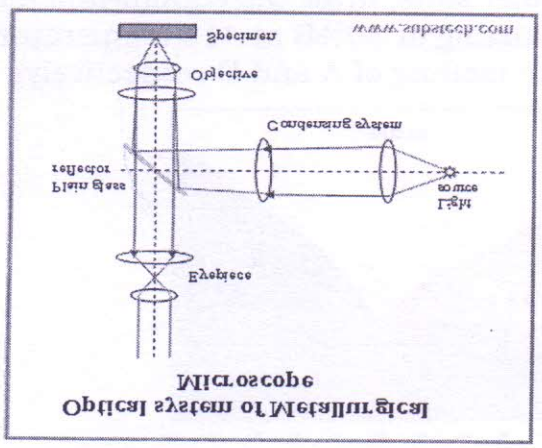
n represents the refractive index of the medium between the objective front lens and the specimen, **μ** or **α** is the one-half angular aperture of the objective

iii] Equilibrium diagram

b) Draw the diagram of metallurgical microscope and label it? [6 marks]
And label it properly?

1 OR 2





c) Write the rules of solid solution formation? [4 marks]

1. Atomic size: the difference in atomic size should not be more than 15%
2. Chemical affinity : Materials having chemical affinity with each other will restrict the solubility
3. Valancy factor : Low valiance material dissolves high in high valance material and vice versa

4. Crystal structure : Materials having same crystal structure can dissolve more in each other

OR

Q.2) a) Define the following [6 marks]

i] Dark field illumination:

In this type of illumination, a circular beam stop is used and light rays are allowed to fall only on the concave reflectors, kept between the objective and specimen surface. The light rays from the concave reflector fall at an appropriate angle on specimen surface and get reflected vertically upwards and come to the eyepiece. This gives an opposite type of contrast and the image is complimentary to the bright field image I.E. grain boundaries are bright

ii] Macro-reagent : Macroscopic observations are done with naked eye without the aid of microscope and the reagents or etching reagent used for the same are known as Macro-reagent

Flow lines detection : 50% H_{CL}

Sulphur printing: 2%aques solution of H_2SO_4

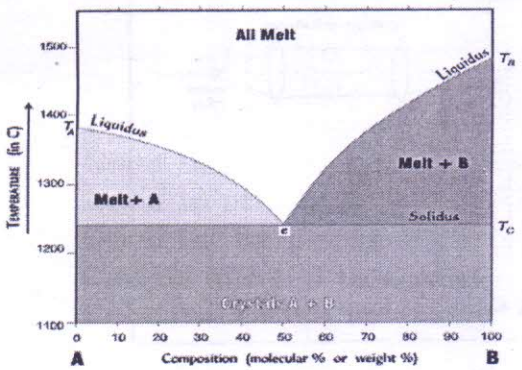
iii] Polishing : the main principle used in reflection and for good reflection the surface needs tobe reflective and parallel. This is done with polishing

There are two types

1Rough polishing: Done with papers

2, Fine polishing i.e. Lapping

b) Two metals are having 100% solubility in liquid state and 0% in solid state, draw the equilibrium diagram when the mixture is existing at 30%B at 415 temperature for reaction and 800 and 1000 are melting of A and B respectively? Label it properly? [6 marks]



The straight line is known as eutectic temp and point C is known as eutectic comp

c) One microscope is having 50X and 20X eyepiece power and 10X as objective lence? Which one will show the clear image and why? [4 marks]

The total magnification is M = M1* M2 where

M1 = Magnication of eyepiece

M2 = Magnication of objective
So for fist the magnification is 500X and second is 200X and which one to be used will depend on the structure not the magnification but as 500X is more it will give the more clarification so 500X should be used

Q.3) a) Define the following [6 marks]

i] Ledeburite: It is a mechanical mixture of cementite and Austenite transferred by eutectic reaction at 1147 from liquid phase. On further cooling it transforms to pearlite at 727 and at room temperature it is called as transformed ledeburite.

ii] Austenite: Interstitial solid solution of carbon in iron of FCC crystal structure having solubility limit of 2.00 wt% at 1147°C with respect to cementite. The stability of the phase ranges between 727-1495° This is not stable structure and changes to pearlite on slow cooling

iii] Delta ferrite: Interstitial solid solution of carbon in iron of body centred cubic crystal structure (δ iron) of higher lattice parameter (2.89Å) having solubility limit of 0.09 wt% at 1495°C with respect to austenite.

b) Write first two reaction with temperature on iron carbon system from lower to higher? [4 marks]

1] Eutectoid, at 727° C with eutectoid composition of 0.8wt% C, two-phase mixture (ferrite & cementite). They are steels.

- γ(0.8 wt% C) ↔α(0.025 wt% C) + Fe3C (6.67wt% C)

2] Eutectic, at 1147° C, with 4.3wt% C, alloys called cast irons.

- L(4.3 wt% C) ↔γ (2 wt% C) + Fe3C (6,67 wt% C)

c) What are the advantage of steel over cast iron? [4 marks]

- **Having carbon up to 2%'**
- **S and P is treated as impurity in a plain carbon steel**
- **Goo impact bearing**
- **Good in tensile**
- **Good in ductility**
- **Good toughness**
- **Good in fatigue**
- **Good in strength**
- **Good in hardness**
- **Can be alloyed to any alloying elements**
- **Relatively high viscosity**

OR

Q.4) a) Define the following [6 marks]

i] Hyper-eutectoid steel: are those that contain more than the eutectoid amount of Carbon. When such a steel cools, except that the primary or pro-eutectoid phase is now cementite instead of ferrite. They are hard and having less machinability and less weldability

ii] Allotropy: I f material is existing in more than one form of crystal structure from room temperature to its melting temperature is called as **ALLOTROPY AND MATERIALS SHOWING THIS ARE CALLED AS ALLOTROPSLIKE FE.**

- At room temperature, iron is B.C.C. in lattice structure, whereas on heating at 910°C it changes to F.C.C.
- Allotropy of Iron is also termed as Polymorphism of Iron.

iii] Pearlite: **Pearlite** is the eutectoid mixture containing 0.80 % C and is formed at 723°C on very slow cooling. This looks like a pearl
It is a very fine plate like or lamellar mixture of ferrite and cementite.
The white ferritic background or matrix contains thin plates of cementite (dark).

- b) Explain what is AISI 1020 and **20 C 6 S 20** [4 marks]

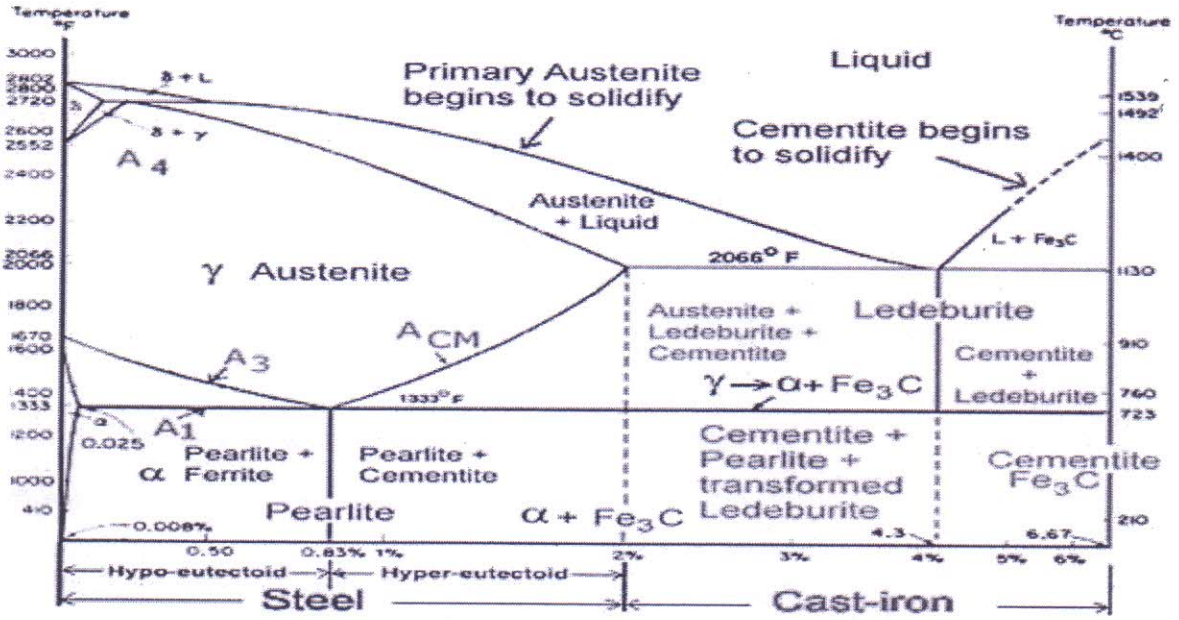
AISI - SAE Classification System AISI XXXX

- **4 digit number**
- **1st number is the major alloying element**
- **2nd number designates the subgroup alloying element OR the relative percent of primary alloying element.**
- **Last two numbers approximate amount of carbon (expresses in 0.01%)**

AISI 1020 is a plain carbon steel having 0,2 % carbon

- En 8 its British standard En stands for Emergency no and its medium carbon steel

c) Draw the Iron Carbon diagram and label it? [4 marks]


Temperature °F
Temperature °C
Primary Austenite begins to solidify
Liquid
Cementite begins to solidify
Austenite + Liquid
L + Fe3C
γ Austenite
2066° F
Austenite + Ledeburite + Cementite
Ledeburite
Cementite + Ledeburite
γ → α + Fe3C
A4
ACM
A3
A1
1333° F
0.025
α Ferrite
Pearlite + Ferrite
Pearlite + Cementite
Pearlite
α + Fe3C
Cementite + Pearlite + transformed Ledeburite
Cementite Fe3C
0.008%
0.50
0.83% 1%
2%
3%
4%
4.3
5%
6%
6.67
Hypo-eutectoid
Hyper-eutectoid
Steel
Cast-iron
