Strength of materials, Engineering Materials & Engineering Mechanics

1. Difference between ferrous and non-ferrous metals. And give examples to each.

Ans: Metals mainly consisting of iron are called ferrous metals, and all other which do not consisting iron are called non-ferrous metals

2. Define the terms Toughness and Hardness.

Ans: Toughness: It is defined as the ability of the material to absorb energy upto fracture during the plastic deformation **(or)** Ability to resist fracture

Hardness: It is defined as the ability of a material to resist indentation or penetration or wear and tear

3. State Gibb's phase rule and abbreviate the terms involved in it.

Ans: The Gibb's phase rule gives the relation between the number of phases (P) and components (C) in a given alloy under equilibrium conditions

$$P + F = C + 2$$

Where, P – number of phases

F – degree of freedom

C – number of components

2 – number of independent variables (temperature & pressure)

4. Define i) Eutectoid steel ii) Hyper-eutectoid steel iii) Hypo-eutectoid steel

Ans: Eutectoid steel: If steel contains 0.8% of carbon are called eutectoid steel. It has 100% pearlite structure

Hyper-eutectoid steel: Steels with carbon content above 0.8% carbon are called hyper-eutectoid steel. It structure consists of pearlite and cementite

Hypo-eutectoid steel: Steels with carbon content less than 0.8% carbon are called hypo-eutectoid steel. It structure consists of ferrite and pearlite

5. What is the purpose of coke and limestone in Blast furnace.

Ans: The function of coke in the blast furnace is to provide heat and to act as a reducing agent. Limestone serves as a flux and combines with impurities to form slag.

6. Name the different heat treatment processes of steel.

Ans: i. Annealing

ii. Normalizing

iii. Hardening

iv. Tempering

v. Surface hardening (Induction and case hardening)

vi. Sub-zero treatment

7. List out different types of Non-destructive tests.

Ans: i. Visual inspection

ii. Penetrant test

iii. Magnetic detection test

iv. Ultrasonic test

v. Radiography test
vi. Spark test

8. Write down the composition and properties of 18/8 stainless steel.
Ans: 18/8 steel consists of 18% chromium and 8% nickel with low percentage of carbon 0.06-0.12%, These steels possess good toughness and ductility as well as high corrosion resistance

9. State the differences between Izod test and Charpy test
Ans: Charpy   &   Izod
   The Dimensions of specimen   :   10*10*55 & 10*10*75
   Method of striking   :   behind the notch & in the direction of notch
   Position of specimen   :   simply supported & cantilever
   Hammer Weight   :   30 kg-m & 18 kg-m

10. Why alloy steels are essential for industrial applications.
Ans: Alloy steels are widely used for industrial applications because, they satisfy the essential requirements of industrial products.
- High hardness and wear resistance
- High toughness and strength
- Good corrosion and heat resistance

11. State the Lami's theorem.
Ans: If three coplanar forces acting at a point are in equilibrium, each force will be proportional to the sine of the angle between the other two forces.

Lami's Theorem

$$\frac{A}{\sin \alpha} = \frac{B}{\sin \beta} = \frac{C}{\sin \gamma}$$
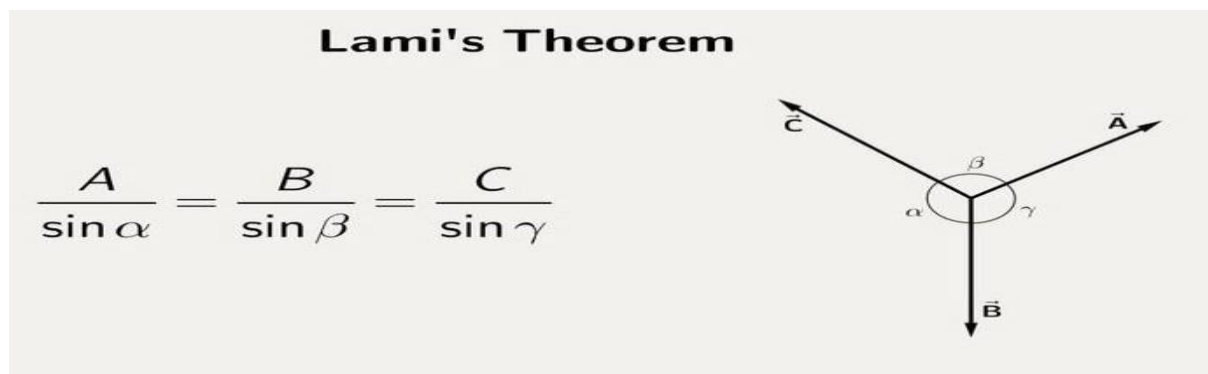
12. Explain the following terms: a) Concurrent forces b) Collinear forces
Ans: a) Concurrent forces: The line of action of all the forces intersect at one point
   b) Collinear forces: The line of action of all forces lie along a single straight line

13. State the term couple and moment of a couple
Ans: Couple : A couple can be described as the moment produced by two equal and opposite forces acting together. Two equal unlike parallel forces, whose line of action are not the same form a couple
Moment of a couple: The product of the arm of a couple and one of the forces forming the couple is known as a moment of a couple

14. What is a simple machine ? List out any three simple machines.
Ans: **Simple machine:** Any machine used to lift a load with small effort is called a lifting machine or simple machine. The examples of simple machines are lever, inclined plane, pulleys, wheel and axle, screw jack etc.

15. State the conditions when mechanical advantage and velocity ratio are equal.
Ans: In case of ideal machine the efficiency is 100%, in that case mechanical advantage (M.A) is equal to velocity ratio (V.R)
$$M.A = V.R$$

16. Define: a) Lateral strain b) Longitudinal strain c) Poisson's ratio
Ans: a) **Lateral strain:** The strain in the direction perpendicular to the applied force is called lateral strain

b) **Longitudinal strain:** The strain in the direction of force is called longitudinal strain

c) **Poisson's ratio:** The ratio of lateral strain to longitudinal strain is called Poisson's ratio. It is denoted by 1/m or μ

17. Write all the relations between elastic constants (E, G & K)
Ans: i) Relation between Young's modulus (E) and Rigidity modulus (G)
$$E = 2G(1 + \frac{1}{m})$$
ii) Relation between Young's modulus (E) and Bulk modulus (K)
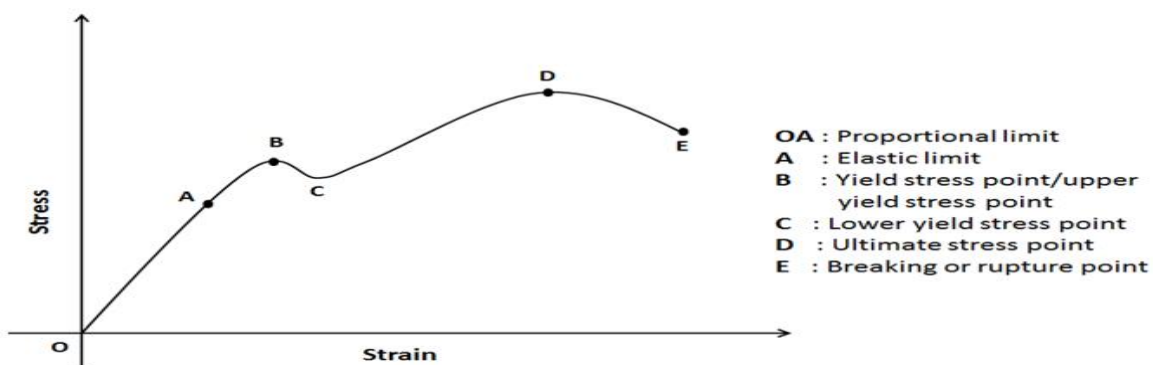$$E = 3K(1 - \frac{2}{m})$$
iii) Relation between Young's modulus (E), Rigidity modulus (G)& Bulk modulus (K)
$$E = \frac{9KG}{3K+G}$$

18. Draw the stress-strain diagram for a ductile material.
Ans:

OA : Proportional limit
A : Elastic limit
B : Yield stress point/upper yield stress point
C : Lower yield stress point
D : Ultimate stress point
E : Breaking or rupture point

19. Define: a) Shear force   b) Bending moment
Ans: a) **Shear force:** It is defined as the algebraic sum of all the forces acting on the beam on one side of the section.

b) **Bending moment:** It is defined as the algebraic sum of all the moments of the forces on one side of the section.

20. Define strain energy and proof resilience.
Ans: **Strain energy:** It is defined as work (energy) stored in the elastic body

Proof resilience: It is defined as the maximum energy stored within the elastic limit.