ENGINEERING MECHANICS VIVA QUESTIONS

Q. 1) **what is Mechanics?**

ANS: It is defined as branch of physical science which is concerned with the study of various forces acting on a body when body is in state of rest or in motion.

Mechanics is sub divided into three Branches; Mechanics of rigid bodies, Mechanics of deformable bodies and Mechanics of Fluids.

In Our course E. M is restricted to study of mechanics of rigid body only

Q. 2) **which are different types of Mechanics?**
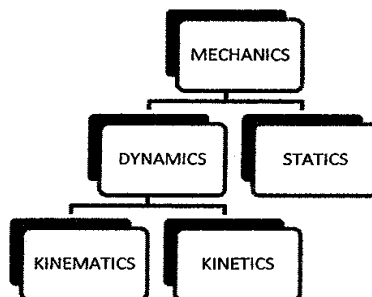
STATICS: It is branch of E. M which deals with various forces acting on a body at rest.

DYNAMICS: It is branch of E. M which deals with study of motion.

KINEMATICS: it is study of motion of a body without consideration of forces which cause motion. It analyses geometry of motion.

KINETICS: Which relates forces acting on the body to motion of body.

Q 3) **RIGID BODY:** On the application of force body does not change its size and shape

Q 4) **Particle:** Considerable mass but Negligible Dimension

Q 5) Newton's First Law of Motion: Every Body continues in its state of rest or in uniform motion in a straight line unless it is acted upon by an unbalanced force.

Q 6) Newton's Second Law of Motion: The rate of change of momentum is directly proportional to the impressed force and takes place in the direction of Force.

Q 7) Newton's Third Law of Motion: For every action there is equal and opposite reaction.

Q 8) FORCE: force is defined as an agency which tends to change the state of rest or of uniform motion of a Body. Force is a Vector Quantity.

Q 9) Characteristics of a Force?

ANS: 1) Magnitude   2) Direction   3) Point Of Application

4) Line of Action: Line along which force acts.

Q 10) **Unit of Force** : S.I unit of force is Newton (N) or Kilo Newton.

1 Newton force is defined as force required to produce an acceleration Of 1 m/s^2 .

Q 11) Explain different types of Forces?

ANS : 1) Coplanar Forces : All forces exist in single plane .

- Concurrent :All the forces Line of action passes through single point
- Parallel : Forces which are parallel to each other
- General Force system: Forces which are neither parallel nor concurrent.

2) Non-Coplanar force : Forces lies in more than one plane .

Q 12) External Effect of a Force : Force when applied on a body , may change or tend to change state of rest or in state of motion of a body .

Q 13) Internal Effect of Force : Under the application of forces on a body internal stresses get set up in body due to which body deforms .

Q 14) System of Force : it is group of forces under consideration.

Q 15) **Law of Parallelogram:** If Two forces acting at a point can be represented in magnitude and direction by two adjacent sides of a parallelogram , drawn from one of its angular points , their resultant by the diagonal of the parallelogram passing through that angular point .

Q 16) **Law of Triangle:** If Two forces acting at a point are represented in magnitude and direction by the two sides of a triangle taken in order their resultant is represented by the third side taken on opposite order.
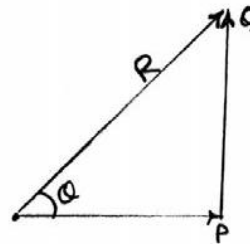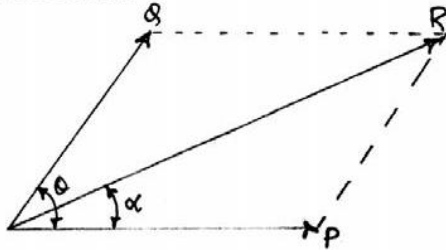
Q 17) **RESULTANT:** It is single force which replaces all the forces acting on a system .

Q 18) Resolution of force : The way of representing single force into number of forces without changing its effect on the body .

Q 19) **Equilibrant:** The equilibrant of two or more forces acting on a body is a single force which when acting with other forces keeps body in equilibrium.

Q 20) what is difference between a resultant force and equilibrant force?

ANS: Resultant force makes the object to move whereas equilibrant force keeps it in equilibrium.

Q 21) state Superposition Principle?

ANS: if more than one force acts on an object, the combined effect due to all the forces is the vector addition of all the individuals effects.

Q 22) **Principle of Transmissibility of force** : Force is a sliding vector continues to act along its line of acton and therefore makes no change it it acts from different point on its line of action on rigid body

Q23)**State Varignon's Theorem?**

ANS : It is the algebraic Sum of moment of all the forces acting on a system is equal to moment of a resultant at the same point . Mathematically written as

$$\sum M_A^F = M_A^R$$

Q24) **Define Couple ?**

ANS: Two non collinear parallel forces having same magnitude but opposite direction forms a couple. Couple is a free vector .

Q 25) **Define Moment ?**

ANS: Turning effect of force produces Moment . M=F X d

Where , M = Moment in N/m   F= Force   d= Perpendicular distance in Metres .

Q 26) **Distinguish Between A Couple and Moment ?**

ANS: Moment represented turning effect of a force whereas couple consist of two equal and opposite forces separated by some distance.

Moment of force varies point to point. Couple is same about any point in plane.

Q 27) Resultant force of a couple system is zero.

Q 28)**Equilibrium** : If Resultant of force system is ZERO , syster\m is said to be in Equilibrium .

Q 29) Condition of Equilibrium : $\sum F_x = 0$ & $\sum F_y = 0$ (Body can not translate)

     $\sum M = 0$ (Body does not Rotate)

Q30) **Lami's Theorem** : it is applicable for only 3 concurrent forces .

If 3 concurrent forces are in equilibrium then the magnitude of each force is proportional to sine of angle between other two forces in system.
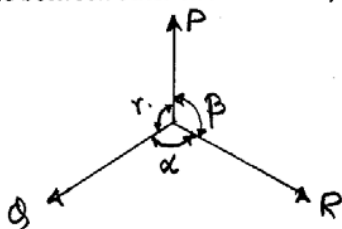
$$\frac{P}{\sin \alpha} = \frac{Q}{\sin \beta} = \frac{R}{\sin \gamma}$$

Q 31) Explain **FREE BODY DIAGRAM (FBD)** ?

ANS: it is diagram of the body under consideration showing all forces , active and reactive acting on the body. FBD gives simple idea about system of forces acting on a body. We are isolating the body From its surrounding and then shows all forces acting on it .
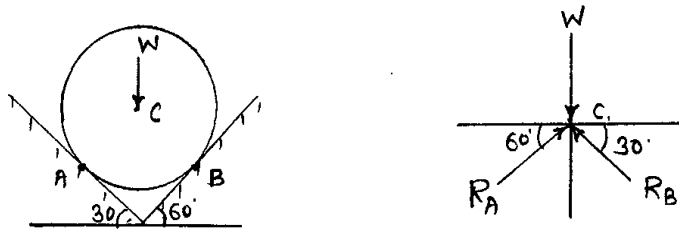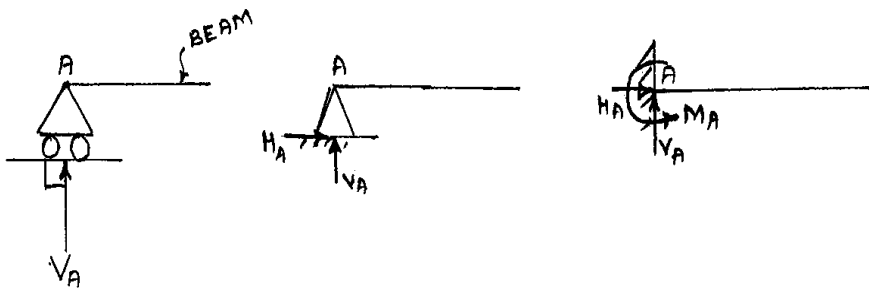

Q 32) **Explain different types of supports ?**

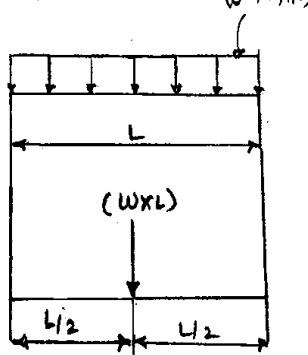ANS: 1) Roller support   2) hinge support   3) Fixed support
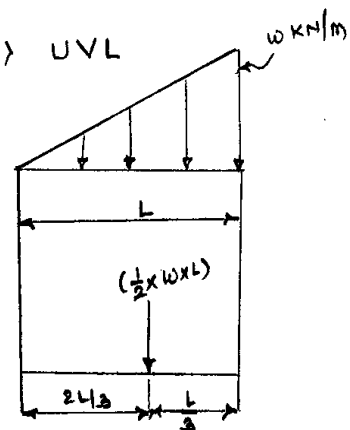

Q33) **Types of load ?**

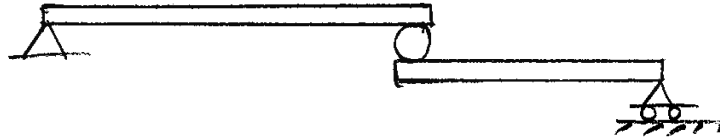1) Point load   2) UDL   3) UVL

Q34) **BEAM** : Beam is a structural member subjected to transverse loading only .

Q 35) **MEMBER** : a two force straight member is always in tension or compression .

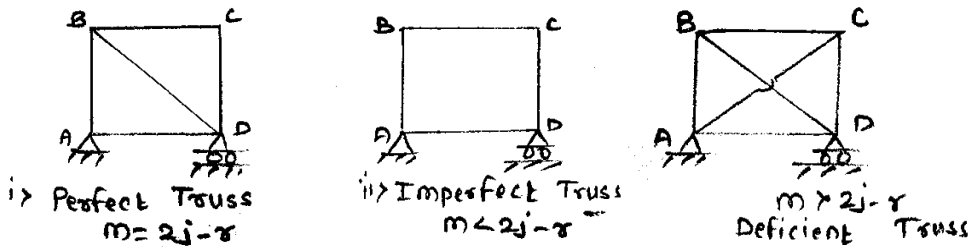Q36)When moment of a force is zero ?

ANS: Moment of a force about a point is zero if its line of action passes through that point

Q 37) Explain Compound Beam ?

Q 38)**Truss**: It is designed to support load and usually stationary .member of a truss is a 2 force member .

Q 39) **Types** :

i> Perfect Truss
$$m = 2j - r$$

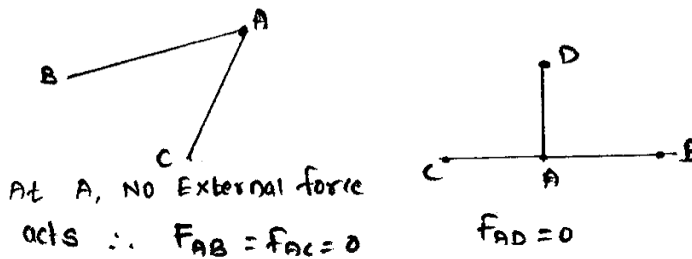ii> Imperfect Truss
$$m < 2j - r$$

$$m > 2j - r$$
Deficient Truss

Q 40) **ASSUMPTIONS IN TRUSSES?**

- Members are straight and rigid .
- Members carries axial loading
- Foce will act at joint only
- Weight of a member is neglected
- Joint is made up of frictionless pins

Q 41) **condition for zero force member ?**

At A, No External force
acts $\therefore F_{AB} = f_{AC} = 0$

$f_{AD} = 0$

Q 42)Method of Analysis : 1) Method of joints : It forms concurrent force system. Max 2 unknowns.

2) Method of section : Maximum 3 unknowns will cut.

FRICTION

Q 43) <u>Friction</u> : May be defined as resistive force acting opposite direction to motion . Frictional force (F) always acts along surfaces. unit of friction is N.

Q 44) dry friction (coulomb Friction) and wet friction .

Q 45) VERGE OF MOTION or IMPENDING MOTION : For a body there will be value of Frictional force up to and body is in equilibrium . Maximum Frictional force is called LIMITING FRICTION .the state of body is called impending motion .

- $F_{max} = \mu N$, μ= coeff. Of friction . , N= normal reaction .
- μ= coeff. Of friction is dimensionless quantity (no unit)

Q46)**Angle of friction (ϕ)** : angle between Normal reaction and resultant reaction

$\tan \phi = \mu$

Q46) **Angle of repose (α)**= it is the minimum angle with respect to horizontal at which body due to its own weight start sliding down the plane.

Q47) Cone of friction : It is imaginary cone generated by revolving resultant reaction about normal reaction .

Q 48) LAW OF FRICTION :

- Frictional force is always opposite to direction of motion.
- Friction is independent of area of contact
- Ratio of limiting Frictional force F_{max} and normal reaction N is constant.

Q 49) Significance of Wedges?

ANS: Wedges are generally used to lift heavy machines or blocks.

Q50) **Centre of Gravity** : it is point through which whole weight of a body is supposed to be act .

Q51) **Centroid** : term used for CG of all plane geometrical figures .

Q 52) Axis of symmetry : line which divides figure into two equal parts , such that each part is mirror image of other .

DYNAMICS

RECTILINEAR MOTION

Q 53) for constant velocity <u>acceleration</u> of a body is zero .

Q54) distance = displacements , when body moves in only one direction of motion .

Q55) For Maximum or minimum velocity <u>acceleration</u> of a body is zero

Q 56) slope of dv/dt gives = <u>acceleration</u>

Q 57) slope of da/dt Gives = <u>JERK</u>

Q58) **area under v-t diagram gives = change in position**

Q59) **area under a-t diagram gives = change in velocity.**

CURVILINEAR MOTION

Q60)a_n=normal component of acceleration a_t= tangential component of acceleration

P= radius of curvature

Q61) for uniform speed a_t= 0

PROJECTILE MOTION

Q61) definition : If any particle is thrown with some initial velocity oyher than vertical direction it follows a path known as Projectile motion

D'Alembert's principle

Q62) **D'Alembert's principle** : the force system consisting of external forces and inertia forces can be consider to keep particle in equilibrium , known as <u>DYNAMIC EQUILIBRIUM</u> .

$\sum$F-m a = 0................................. D'Alembert's principle

$\sum$F =m a....................................Newton's 2 nd law.

Q 63) **WORK –ENERGY PRINCIPLE** :for a particle moving under action of forces, total work done (WD) by these forces is equal to change in kinetic energy.

<u>WORKDONE= CHANGE IN KINETIC ENERGY</u>

Q 64) Spring force: force in a spring is variable as it is proportional to deformation X and directed towards neutral position .

Q 65)**IMPULSE** : Is the Product of force and duration for which its acts .

Q66) **Momentum** : Prodoct of mass * Velocity

Q 67)**Impulse Momentum Equation** : momentum of a body changes and change in momentum is equal to impulse produced by force .

Q 68) **Impact** : collision of two bodies takes place during very short interval of time .

Central impact: mass centres of both bodies are in line of impact

Oblique Impact : mass centres of both bodies are **NOT** in line of impact

Q 69) Coeff. Of restitution (e) :it is velocity difference after the impact to vel. Difference before impact .

- e=0 ....Perfectly plasic impact
- e=1....................... Perfectly Elastic impact

Q 70) instantaneous centre of rotation (ICR)

- ICR is a point of zero velocity
- ICR is a point of pure rotation
- ICR is an imaginary point .