GRAVITATION

1. Basic forces in nature :

i) Gravitational force
ii) Electromagnetic force
iii) Strong nuclear force
iv) Weak nuclear force

The ratio strengths of gravitational, weak nuclear , Electro magnetic and strong nuclear forces respectively are $1:10^{31}:10^{36}:10^{38}$

Gravitation

Is the name given to the force of attraction between any two bodies of the universe.

Gravity

Is the force of attraction exerted by earth towards its center on a body lying on or near the surface of earth. Gravity is merely a special case of gravitation and is also called earth's gravitational pull. Weight of a body is defined as the force of attraction exerted by the earth on the body towards in center.

2. Law of Universal Gravitation:

Statement: The gravitational force of attraction between two bodies is directly proportional to the product of their (inertial) masses and inversely proportional to the square of the distance between their centers. This force acts along the line joining the centers of the two bodies.

$$F = \frac{Gm_1m_2}{r^2}$$

3. Definition of G: The universal gravitational constant is numerically equal to the force of attraction between two unit masses separated by unit distance.

4. Value and units of G:

a. In S.I. 6.67 x 10^{-11} newton - m^2 kg^{-2}

5. Relation Between 'G' and 'g':

Relation between 'Gravitational constant' and acceleration due to gravity is.

$$g = \frac{GM}{R^2}$$

6. Variation of 'g':

a. Acceleartion due to gravity at certain altitude (height)'a' is given by

$$\therefore g_a = g\left(1-\frac{2h}{R}\right)$$

for h << R

b. Acceleartion due to gravity at certain depth 'd' is given by

$$\therefore g_d = g\left(1-\frac{h}{R}\right)$$

c. Acceleartion due to gravity at certain Latitude ϕ is given by

$$g_\phi = g - R\omega^2\cos^2\phi$$

7. Gravitational field strength :

It is defiend as gravitational force per unit mass placed at that point.

$$E = \frac{F}{m}$$

On the surface of the earth

$$E = \frac{F}{m} = \frac{mg}{m} = g$$

8. Chandrashekar limit :

The maximum mass that a white dwarf can have is called chandrashekar limit.
It is equal to 1.4 times the sun mass .

9. Frame of references :

a. A frame of reference describes the posi tion of an object in space.

b. There are two types of reference frames.
i) inertial frame of reference
ii) Non-inertial frame of reference

i) inertial frame of reference :
The frame of reference in which newton's laws hold good is called inertial frame of references
Ex : The reference frame at rest.
ii) Non-inertial frame of reference :
The frame of reference in which newton's laws of motion do not hold good is called non inertial frame of reference.

Ex : The linearly accelerating frame (or) a rotating frame

c. The acceleration of a body in inertial frame of reference is due to real forces.

d. The acceleration of a body in non inertial frame of reference is due to pseudo forces.

10. Mass :

Mass is defiend as the amount of mater contained in a body. mass of a body can be found by two different methods. Those are

i) Inertial mass

ii) Gravational mass

i) Inertial mass :

The property of a body to mesasure its resistance to acceleration is called its inertial mass

ii) Gravational mass :

The property of a body responsible for the gravitonal force it excerts on another body is called gravitonal mass.

a. It has been expermently observed that inertial mass and gravitonal mass are equal

11. Principle of equivalence:

Definition: Experiments conducted in inertial and non- inertial frames of reference under identical conditions, the results obtaine are same, this consequence is called Principle of equivalence.

12. Orbital Velocity:

Definition : The speed of a satellite in its orbit is called orbital velocity. (or) it is the velocity with which a body should be projected in order that it may revolve round the earth in an orbit. $v_0 = \sqrt{gR}$

13. Escape velocity (V_e):

Definition: The minimum velocity with which a body should be projected to overcome the earth's gravitational field is called the escape velocity.

$V_e = \sqrt{2gR}$

14. Geo-Stationary satelite :

A satelite whose period of revolution is equal to period of rotation of earth (or) 24 hours is calld Geo-stationary satelite.

a. They appear stationary for an observer on the earth