Physics Notes on Gravitation and Satellite

➤Gravitation:

• Each and every massive body attracts each other by virtue of their masses. This phenomenon is called gravitation.

➤Newton's law of Gravitation :

• The gravitational force of attraction between two bodies is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

➤Gravitational force (F)=Gm1m2/ r ^{2}

• Where G is the gravitational constant its value is **6.67×10^{-11} $Nm^2kg^{-2.}$**

• m1, m2 is the mass of two bodies and r is the distance between them.

• Gravitational force is central as well as a conservative force.

➤Acceleration Due to Gravity of Earth:

• The acceleration produced in a body due to the gravitational pull of the earth is called acceleration due to gravity.

$g=GM/R^2$ where M is the mass of earth and R is the radius of the earth.

• The value of g changes slightly changes from place to place but its value near the earth's surface is **$9.8ms^{-2.}$**

• Gravitational force is the **weakest** force in nature.

➤The condition affecting the value of g:

• **The shape of Earth:** Earth shape also affect the value of acceleration due to gravity that's why g is maximum at poles and minimum at the equator.

• **Rotation** of Earth on its axis:

g decreases due to the rotation of Earth

g decreases if the angular speed of Earth increases and increases if the angular speed of Earth decreases.

• **Effects of Altitude:** The value of g decreases with the increase in height.

• **Effects of depth**: The value of **g decreases** with depth and become zero at the centre earth.

➤Mass and Weight:

• The mass of a body is the quantity of matter contains in it and it is a scalar quantity and its SI unit is **Kg.**

• Mass of a body does **not change** from place to place.

• The weight of the body is the force with which it is attracted towards the centre of the earth and it is given by w=mg.

• Weight of the body is a vector quantity and its unit is Newton

• The centre of gravity of a body is that point at which the whole weight of the body appears to act.

• The weight of the body is **a variable** quantity and it changes from place to place.

➤The weight of a body in a lift:

• When the lift is at rest or in uniform motion then the apparent weight is equal to the real weight of the body, **w=mg**.

• When the lift is accelerating upward then the apparent weight is greater than the real weight of the body i.e. **w=m(g+a)**

• When the lift is accelerating downward then the apparent weight of the body is less than the real weight of the body i.e. **w=m(g-a).**

• When the lift is falling freely under gravity the apparent weight of the body is zero i.e.

w=m(g-g) as a =g

w=0

• The weight of the body on **the moon** is lesser than the weight of the body on earth as the acceleration due to gravity at the moon is less than the acceleration due to gravity on earth.

Note- Acceleration due to gravity on Earth is **6 times** than that of on the moon.

➤Planets:

• Planets are the heavenly bodies which revolve around the sun in a specific orbit or path.

• Our solar system contains eight planets as Pluto losses its planet status.

➤Kepler's Laws of Planetary Motion:

Kepler gives three laws which are as follows:

• All planets revolve around the sun **in elliptical orbits** with the sun at its one focus.

• The real speed of the planet around the sun is constant.

• The square of the time period of revolution of a planet around the sun is directly proportional to the **cube** of the semi-major axis of its elliptical orbit

➤Satellite:

• A heavenly body revolving around a planet in an orbit is called a satellite.

• Moon is the natural satellite of the earth.

There are two types of artificial satellites:

➤Geosynchronous Satellite:

• A **geosynchronous satellite** is a satellite in geosynchronous orbit, with an orbital period the same as the Earth's rotation period.

• A special case of the geosynchronous satellite is the **geostationary satellite**, which has a geostationary orbit – a circular geosynchronous orbit directly **above the Earth's equator**.

• They revolve around the earth at the height of 36000 Km

• Their period of rotation is the same as the earth’s time period of rotation around its own axis i.e. 24 hours.

• These satellites appear to be stationary.

• The geostationary satellite is used to telecast TV programmes, weather forecasting, in predictions of floods and droughts.

➤Polar Satellite:

• These satellites revolve around the earth in polar orbits at a height of around 800 km.

• The time period of rotation of these satellites is 84 minutes.

➤Period of Revolution of a satellite:

• Time taken by a satellite to complete one revolution in its orbit is called it is a period of revolution.

• Period of revolution= Circumference of orbit/ orbital speed

• Period of revolution of a satellite depends upon the height of satellite from the surface of the earth, greater its height from earth surface more will be its period of revolution.

• Period of revolution is independent of its mass.

➤Escape Velocity:

• The minimum velocity with which when an object is thrown vertically upwards from the earth's surface just crosses the earth's gravitational field and never returns.

• Escape velocity=$(2gr)^{1/2}$

• When orbital speed is increased by 41% i.e $\sqrt{2}$ times then it will escape from its orbit.

• Its value on earth surface is 11.2 km/sec

• Escape velocity at the Moon's surface is 2.4 km/s.