QUES 07:- Let us assume that our galaxy consists of $2.5 \times 10^{11}$ stars each of one solar mass. How long will a star at a distance of 50,000 ly from the galactic centre take to complete one revolution? Take the diameter of the Milky Way to be $10^5$ ly.

**Sol.** Number of stars in our Galaxy (N) = $2.5 \times 10^{11}$

Mass of each stars = $2 \times 10^{30}$kg

So, mass of the stars of the galaxy(M) = $2.5\times 10^{11}\times 2\times 10^{30}$

= $5 \times 10^{41}$ Kg

Radius of orbit of a star (r) = 50000 light-years

We know,

1 light years = $9.46 \times 10^{15}$ m

So, r = $50000\times9.46\times10^{15}$ m

= $5 \times 9.46 \times 10^{19}$ m

Centripital force = Gravitational force

$mv^2/r = GMm/r^2$

$v^2 = GM/r$

$(2\pi r/T)^2 = GM/r$ [$v = 2\pi r/T$]

$4\pi^2r^2/T^2 = GM/r$

$T^2 = 4\pi^2r^3/GM$

Put the values of r , G and M

$T = \sqrt{\{ 4\times(3.14)^2\times (5\times9.46\times10^{19})^3/6.67\times10^{-11}\times5\times10^{41}\}}$

= $111.93 \times 10^{14}$ sec

= $111.93 \times 10^{14}/(365\times24\times3600)$ yr

= $3.55 \times 10^8$ yr